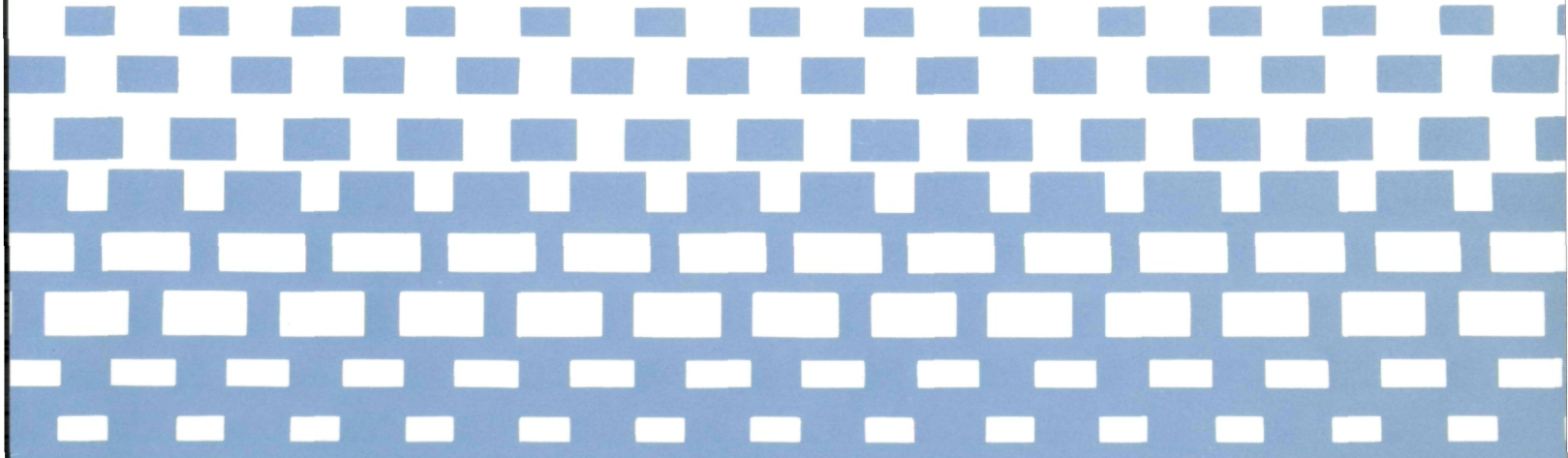
NASA SP-7011 (377)
July 1993

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES



(NASA-SP-7011(377)) AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 377) (NASA) 82 p

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NASA SP-7011 (377)
July 1993

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC 1993

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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 223 reports, articles and other documents recently announced in the NASA STI Database. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue include:

Scientific and Technical Aerospace Reports (STAR) (N-10000 Series)	N93-22536 — N93-25137
International Aerospace Abstracts (A-10000 Series)	A93-29781 — A93-33480

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract, report number, and accession number—are included.

A cumulative index for 1993 will be published in early 1994.

Information on availability of documents listed, addresses of organizations, and CASI price schedules are located at the back of this issue.

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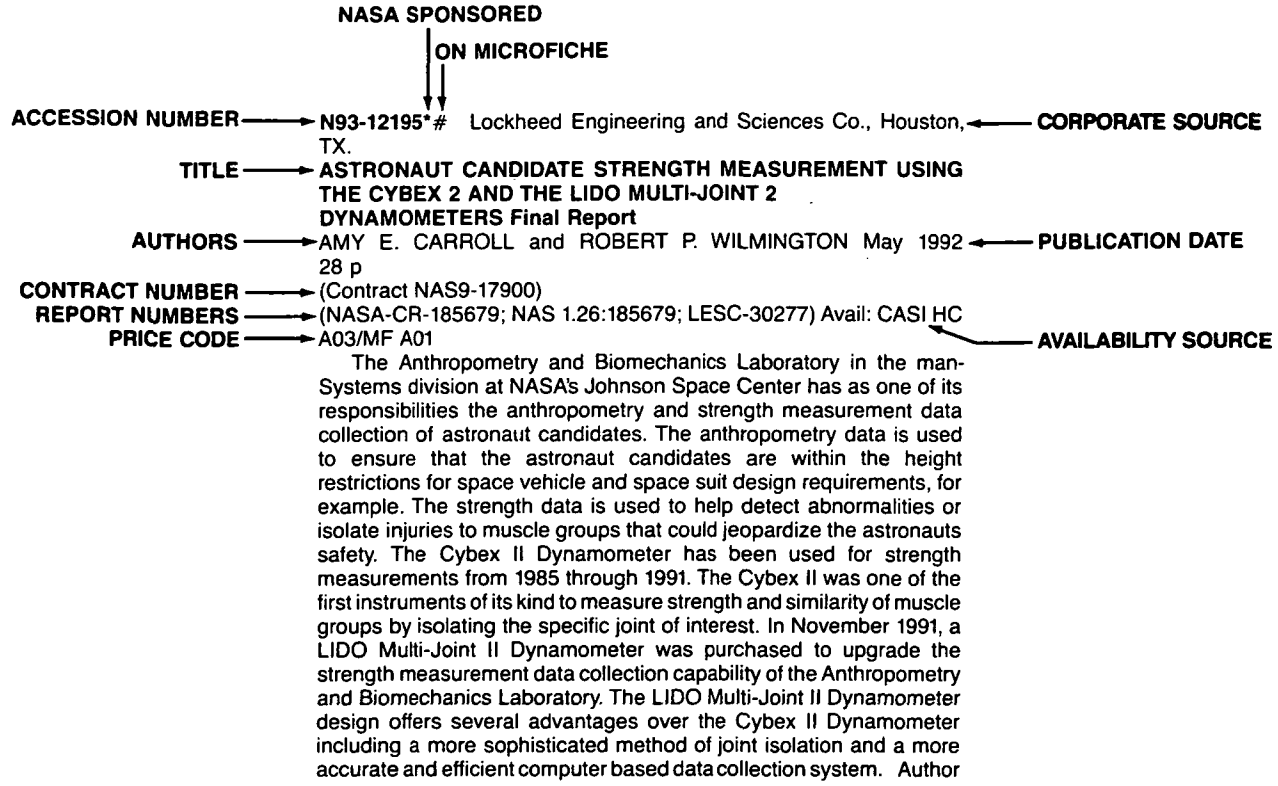
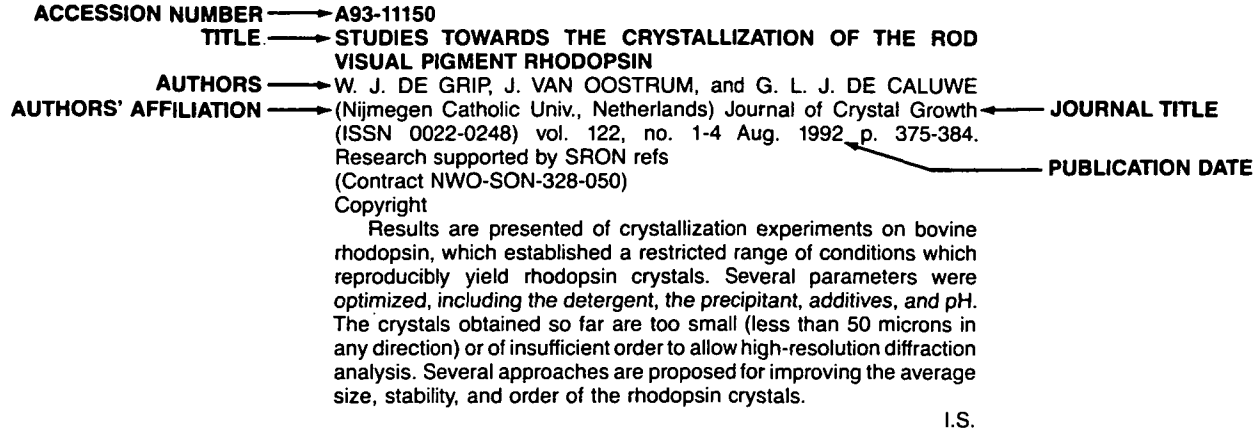
TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 377)

July 1993

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LIFE SCIENCES (GENERAL)

A93-30437
EFFECT OF HEAT ACCLIMATIZATION ON CAMP LEVEL IN PLASMA, CEREBROSPINAL FLUID AND PREOPTIC AREA-HYPOTHALAMUS IN HYPERTHERMAL RABBITS
REN-ZHI QIU (First Military Medical Univ., Guangzhou, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 250-255. In Chinese. refs

In order to elucidate the effect of heat acclimatization on the cAMP level in the plasma, cerebrospinal fluid, and preoptic area-hypothalamus in hyperthermal rabbits, healthy adult rabbits were divided into four groups: heat stress group, 6-d heat acclimatized group, 11-d group, and 16-d group. The cAMP contents were measured in plasma, cerebrospinal (CSF) and preoptic area-hypothalamus (POAH) from six rabbits of each group before heat and during Tr 41.5 and 42.5 C at the last heat exposure. The duration of heat tolerance to the last heat exposure of group 2 to 4 increased by 26-45 percent as compared with that to the first exposure. It is shown that after heat acclimatization (groups 3 and 4), the duration of heat tolerance increased significantly. The changes of cAMP content in plasma, CSF, and POAH reflect the alleviation of the autonomic nervous reaction to heat stress, especially in group 4. The source of cAMP in CSF was closely related to its metabolism in POAH. P.D.

A93-30438
EFFECT OF SIMULATED WEIGHTLESSNESS ON MICROVESSEL PERMEABILITY OF VARIOUS ORGANS IN RABBITS
QIU-LU XIANG (Inst. of Space Medico-Engineering, Beijing, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 256-262. In Chinese. refs

A study of a hypokinesia animal model of head down tilt of 20 deg was reported. Forty rabbits were divided into 5 groups (8 in each group). Permeability of microvessels in rabbits' brain, left ventricular muscle, right lung, liver, spleen, kidney (renocortex and medulla), adrenal gland and the muscle in left femoribus internus was measured with serum albumin. Meanwhile, serum albumin and blood sugar were determined. The dynamic response curves of microvessel permeability in nine important organs, such as the brain and heart, during 15 day-simulated weightlessness were given. The characteristics of the changes were highly related to function of the various organs. The results showed that the change of permeability of microvessels might reflect the adaptive process of various organs to simulated weightlessness. Author

A93-30441
INFLUENCE OF SPACE-FLIGHT FACTORS ON GROWTH OF SPIRULINA
JING-SHEN PEI (Inst. of Space Medico-Engineering, Beijing, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 277-280. In Chinese. refs

With the advent of space flight, there is renewed interest in the use of algae to regenerate oxygen, absorb carbon dioxide and treat wastes in a future biological life-support system. Spirulina is a potential algae originator to provide food and air revitalization for manned space missions. The influence of space-flight factors, especially weightlessness on the growth of spirulina flown for 8 days in a recoverable satellite was studied by postflight cultivation. The morphology, growth, and development of spirulina in space was not significantly different from those of the ground-based controls, but the growth rate of logistic growth period of spirulina in the satellite was faster than that on the ground (p is less than 0.05). Author

A93-30442
EFFECT OF ACUTE HYPOXIA EXPOSURES ON PLASMA ENDOTHELIN IN RATS
WEI-WEI HAO (Naval General Hospital, Beijing, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 281-285. In Chinese. refs

The endothelin (ET) contents in plasma are determined with radioimmunoassay after different hypoxia exposures. The plasma ET content in the control group (n = 20), single exposure group (n = 17), male rats multiple exposure group (n = 11), and female rats multiple exposure group (n = 9) are found to be 50.29 +/- 1.89, 71.27 +/- 5.40, 106.11 +/- 8.82, and 77.88 +/- 8.45 pg/ml, respectively. The ET content of plasma in rats of the single- or multiple-exposure group increased markedly as compared to that in rats of the control group (p is less than 0.01 or 0.001). It is shown that both single and multiple exposures to acute moderate hyposia may lead to significant increases of plasma ET content in rats. P.D.

A93-30444
EFFECTS OF COLD INJURY ON SERUM ANGIOTENSIN CONVERTING ENZYME ACTIVITIES IN RATS
FENG-ZHI LI (Academy of Military Medical Sciences, Tianjin, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 291-294. In Chinese. refs

Results are presented from an experimental study tracing changes of angiotensin I converting enzyme (ACE) activity in the serum of rats after freezing, as well as the relationship of these changes with degrees of cold injury. The serum ACE activity is determined by means of UV spectrophotometry. Increases in serum ACE activity are closely related to the degree of cold injury. It is suggested that freezing damage of vascular endothelial cells may lead to an increase in the release of ACE, which may play an important role in the pathological process in cold injury. P.D.

A93-30511* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANTAGONISTIC OTOLITH-VISUAL UNITS IN CAT VESTIBULAR NUCLEI
NANCY G. DAUNTON (NASA, Ames Research Center, Moffett Field, CA) and CAROL A. CHRISTENSEN (Vassar College, Poughkeepsie, NY) New York Academy of Sciences, Annals (ISSN 0077-8923) vol. 656 May 22, 1992 p. 924-926. refs
Copyright

The nature of neural coding of visual (Vis) and vestibular (Vst) information on translational motion in the region of the vestibular nuclei was investigated using extracellular single-unit recordings in alert adult cats. Responses were recorded and averaged over

60 cycles of stimulation in the vertical and horizontal planes, which included the Vst (movement of the animal in the dark), Vis (movement within lighted visual surround), and combined Vis and Vst (movement of the animal within the lighted stationary visual surround). Data are reported on responses to stimulations along the axis showing maximal sensitivity. A small number of units were identified that showed an antagonistic relationship between their Vis and Vst responses (since they were maximally excited by Vis and by Vst stimulations in the same direction). Results suggest that antagonistic units may belong to an infrequently encountered, but functionally distinct, class of neurons. I.S.

A93-31188
CHANGES IN THE OSMOLALITY, MONOVALENT CATION CONCENTRATION, AND PROTEIN STRUCTURE OF BLOOD PLASMA UNDER EXTREME CONDITIONS [IZMENENIE OSMOLIAL'NOSTI, KONTSENTRATSII ODNOVALENTNYKH KATIONOV I STRUKTURY BELKOV PLAZMY KROVI PRI EKSTREMAL'NYKH VOZDEISTVIIAKH]
M. M. SOKOLOVA, A. A. PANOV, V. S. SAAKOV, and V. G. LEONT'EV (RAN, Inst. Evoliutsionnoi Fiziologii i Biokhimii, St. Petersburg, Russia) Rossiiskaia Akademiia Nauk, Doklady (ISSN 0869-5652) vol. 327, no. 2 1992 p. 277-280. In Russian. refs
Copyright
Results of hyperbaric experiments conducted on male rats are reported. An analysis of the results indicates the existence of a relationship between the osmolality, active ion concentration, and amino acid composition of blood plasma. It is suggested that this relationship is one of the components of the general adaptive response of an organism under prolonged exposure to extreme conditions. V.L.

A93-31190
ON A POSSIBLE ROLE OF CARBON DIOXIDE IN THE GENESIS OF THE HYPERBARIC NEURAL SYNDROME [O VOZMOZHNOI ROLI UGLEKISLOGO GAZA V GENEZE NERVNOGO SINDROMA VYSOKIKH DAVLENII]
T. E. TIMOSHENKO (RAN, Inst. Evoliutsionnoi Fiziologii i Biokhimii, St. Petersburg, Russia) Rossiiskaia Akademiia Nauk, Doklady (ISSN 0869-5652) vol. 327, no. 3 1992 p. 405-407. In Russian.
Copyright
The effect of the CO2 accumulation in the organism subjected to high atmospheric pressure on the development of the hyperbaric neural syndrome is discussed. A new concept is proposed according to which hyperbaric conditions induce the formation of a relationship between the rate of CO2 leaving the cell and the energy content in the energy-converting cellular membranes. I.S.

A93-31530
ULTRASTRUCTURAL AND BIOCHEMICAL STUDIES ON MUSCLE ATROPHY INDUCED BY SUSPENSION AND SUSPENSION WITH DENERVATION IN LOWER LIMBS OF RATS
HIROTO FUJIYA (St. Marianna Univ., Kawasaki, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723) vol. 29, no. 4 Dec. 1992 p. 95-105. In Japanese. refs
Copyright
To evaluate the influences of the sciatic nerves on the slow soleus and fast extensor digitorum longus muscles of rat, the changes in histochemical, biochemical, and ultrastructural characteristics in the muscles loaded by tail suspension with denervation are investigated. There are some differences in the structural and functional profiles observed in the atrophied muscle induced by suspension, denervation, or suspension with denervation. Apparent increase in the numbers of fast-twitch fiber and decrease in slow-twitch fiber were calculated in the fast muscle of suspension-with-denervation group compared with suspension-only or denervation-only group. The suspension with denervation strongly affected on the fast muscle rather than the slow muscle, suggesting that the neurotrophic effect and nerve signals would act on the maintainance of the fiber type and contractile properties. Slight decreases in nomalized glycolytic and oxidative enzyme activities were obtained in all groups except for the suspension-only group. The activity of malate dehydrogenase, but not succinate dehydrogenase, both of them known as oxidative enzyme, tended to increase in the fast muscle from the suspension-with-denervation group, supporting an acceleration on the action of malate-asparate shuttle in the muscle tissue in order to maintain for muscle function. Author

A93-31628 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ATOMIC STRUCTURE AND CHEMISTRY OF HUMAN SERUM ALBUMIN
XIAO M. HE and DANIEL C. CARTER (NASA, Marshall Space Flight Center, Huntsville, AL) Nature (ISSN 0028-0836) vol. 358, no. 6383 July 16, 1992 p. 209-215. Research supported by NASA refs
Copyright
The three-dimensional structure of human serum albumin has been determined crystallographically to a resolution of 2.8 A. It comprises three homologous domains that assemble to form a heart-shaped molecule. Each domain is a product of two subdomains that possess common structural motifs. The principal regions of ligand binding to human serum albumin are located in hydrophobic cavities in subdomains IIA and IIIA, which exhibit similar chemistry. The structure explains numerous physical phenomena and should provide insight into future pharmacokinetic and genetically engineered therapeutic applications of serum albumin. Author

A93-32071
CULTIVATION OF HAMSTER KIDNEY CELLS IN A DYNAMIC CELL CULTURE SYSTEM IN SPACE (SPACELAB IML-1 MISSION)
GIOVANNA LORENZI, FELIX K. GMUENDER, and AUGUSTO COGOLI (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland) Microgravity - Science and Technology (ISSN 0938-0108) vol. 6, no. 1 March 1993 p. 34-38. Research supported by ESA, Contraves AG, and Eidgenoessische Technische Hochschule Zuerich refs
(Contract SNSF-3,338,0,86)
Copyright
Cell proliferation, tissue plasminogen activator (t-PA) production and metabolic changes of Hamster Kidney cells (HaK) grown on microcarriers in an automatic Dynamic Cell Culture System (DCCS) were determined on the first International Microgravity Mission Spacelab. The DCCS was designed for two cell culture chambers, one operating as a batch system, the other as a perfusion system. Medium exchange was achieved with an osmotic pump. Two major items were investigated: the biological performance of the DCCS in space, and the effect of microgravity on HaK cells. The results obtained demonstrated that the DCCS can be used for biological experiments on long term Spacelab missions. Microgravity had no effect on cell growth and metabolism of HaK cells. Author

A93-32072
ALTERATION OF STRUCTURE AND MOBILITY OF ERYTHROCYTE AGGREGATES UNDER NORMAL- TO MICROGRAVITY CONDITIONS
MEGHA SINGH (Indian Inst. of Technology, Madras, India), JAN MIDDELBERG (Bremen Univ., Germany), G. RAMACHANDRAN (Indian Inst. of Technology, Madras, India), and HANS J. RATH (Bremen Univ., Germany) Microgravity - Science and Technology (ISSN 0938-0108) vol. 6, no. 1 March 1993 p. 39-42. Research supported by Humboldt Foundation refs
Copyright
An experimental analysis of the aggregates structure and their mobility under normal- and micro-g conditions is carried out. Fresh well mixed erythrocyte suspensions in plasma at 8.0 percent hematocrit are placed in a glass chamber and on-line video microscopic recording of the aggregation process under microgravity condition is carried out. The analysis of aggregate

structure and mobility are carried out by an IBM-PC/AT based image processing system. The results show that (1) under normal gravity conditions the velocity of the formed aggregates depend on their sizes which tend to grow further by interacting with single cells and small aggregates, and (2) under microgravity conditions, the mobility of the aggregates reduces to zero and an alteration in their structural parameters is observed. Author

A93-32113* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COGNITIVE COMPETENCIES - PRODUCTS OF GENES, EXPERIENCE, AND TECHNOLOGY
DUANE M. RUMBAUGH and E. S. SAVAGE-RUMBAUGH (Georgia State Univ., Atlanta; Yerkes Regional Primate Research Center, Decatur) *In* Topics in primatology. Vol. I - Human origins Tokyo University of Tokyo Press 1992 p. 293-304. Research supported by Georgia State Univ. refs
(Contract NIH-RR-00165; NIH-HD-06016; NAG2-438)
Copyright

The paper examines methods used in studying cognitive competency in primates. Citing experiments on teaching language skills to chimpanzees, it is shown that some methods used for inquiry might lead to the cultivation and generation of new competencies, and specifically to the development of observational and relational learning skills. It is noted that methods can also limit the generality of conclusions; erroneous conclusions may be made based on certain generally accepted methods, whereby the research might be treatments that profoundly determine the assessment of dependent variables. Particular attention is given to the role of age in learning, showing that young primates can be taught the meaning of lexigrams and many specific tasks in much shorter time than adults; on the basis of these experiments, it was concluded that cultural gains did evolve primarily as a consequence of context within which infants were growing. AIAA

A93-32115* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PURIFICATION AND PROPERTIES OF AN ATPASE FROM SULFOLOBUS SOLFATARICUS
LAWRENCE I. HOCHSTEIN (NASA, Ames Research Center, Moffett Field, CA) and HELGA STAN-LOTTER (NASA, Ames Research Center, Moffett Field; SETI Inst., Mountain View, CA) Archives of Biochemistry and Biophysics (ISSN 0003-9861) vol. 295, no. 1 May 15, 1992 p. 153-160. refs
(Contract NCC2-578)
Copyright

The paper reports properties of a sulfite-activated ATPase from Sulfolobus solfataricus, purified using ammonium sulfate precipitation, column chromatography on UltraGel and Sepharose 6B, and SDS-PAGE. The 92-fold purified enzyme had a relative molecular mass of 370,000. It could be dissociated into three subunits with respective molecular masses of 63,000, 48,000, and 24,000. The ATPase activity was found to be inhibitable by nitrate, N-ethylmaleimide (which bound predominantly to the largest subunit), and 4-chloro 7-nitrobenzofurazan, but not by azide, quercetin, or vanadate. While the ATPase from S. solfataricus shared a number of properties with the S. acidocaldarius ATPase, there were also significant differences suggesting the existence of several types of archaeal ATPases. AIAA

A93-32116 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NUCLEOTIDE-PROTECTABLE LABELING OF SULFHYDRYL GROUPS IN SUBUNIT I OF THE ATPASE FROM HALOBACTERIUM SACCHAROVORUM
MICHAEL SULZNER, HELGA STAN-LOTTER (Wien, Univ., Vienna, Austria), and LAWRENCE I. HOCHSTEIN (NASA, Ames Research Center, Moffett Field, CA) Archives of Biochemistry and Biophysics (ISSN 0003-9861) vol. 296, no. 1 July 1992 p. 347-349. Research supported by BMFWF and NASA refs
(Contract NCC2-578)
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The membrane ATPase from Halobacterium saccharovorum was purified as described by Hochstein et al. (1987) and was incubated with C-14 labeled N-ethylmaleimide (NEM), with and without adenine nucleotides, to determine the effect of nucleotides on the enzyme labeling. It was found that NEM incorporates into the 87,000-Da subunit (subunit I) of the enzyme and that the conditions for enzyme modification are similar to those which result in the inhibition of the enzyme activity. The presence of ATP, ADP, and AMP was found to reduce both the inhibitor incorporation and enzyme inhibition. It was shown that the reaction involves a modification of thiol groups. AIAA

A93-32118* National Aeronautics and Space Administration, Washington, DC.
EFFECTS OF SYSTEMIC L-TYROSINE ON DOPAMINE RELEASE FROM RAT CORPUS STRIATUM AND NUCLEUS ACCUMBENS
MATTHEW J. DURING, IAN N. ACWORTH, and RICHARD J. WURTMAN (MIT, Cambridge, MA) Brain Research (ISSN 0006-8993) vol. 452 1988 p. 378-380. Research supported by USAF, Center for Brain Sciences and Metabolism Charitable Trust, and NASA refs
Copyright

Intracerebral dialysis was used to monitor extracellular fluid from rat striatum and nucleus accumbens following the intraperitoneal administration of tyrosine. Dopamine concentrations in dialysates from both the striatum and the nucleus accumbens increased significantly in response to the tyrosine. The magnitude of the tyrosine effect was greater in the nucleus accumbens than in the striatum. Hence, mesolimbic dopaminergic neurons may be especially responsive to precursor availability. Author

A93-32119* National Aeronautics and Space Administration, Washington, DC.
SEROTONIN RELEASE VARIES WITH BRAIN TRYPTOPHAN LEVELS
JUDITH D. SCHAECHTER and RICHARD J. WURTMAN (MIT, Cambridge, MA) Brain Research (ISSN 0006-8993) vol. 532 1990 p. 203-210. Research supported by NASA, USAF, Center for Brain Sciences and Metabolism Charitable Trust, and MIT refs
(Contract NIH-T32-MH-19761-0851)
Copyright

This study examines directly the effects on serotonin release of varying brain tryptophan levels within the physiologic range. It also addresses possible interactions between tryptophan availability and the frequency of membrane depolarization in controlling serotonin release. We demonstrate that reducing tryptophan levels in rat hypothalamic slices (by superfusing them with medium supplemented with 100 microM leucine) decreases tissue serotonin levels as well as both the spontaneous and the electrically-evoked serotonin release. Conversely, elevating tissue tryptophan levels (by superfusing slices with medium supplemented with 2 microM tryptophan) increases both the tissue serotonin levels and the serotonin release. Serotonin release was found to be affected independently by the tryptophan availability and the frequency of electrical field-stimulation (1-5 Hz), since increasing both variables produced nearly additive increases in release. These observations demonstrate for the first time that both precursor-dependent elevations and reductions in brain serotonin levels produce proportionate changes in serotonin release, and that the magnitude of the tryptophan effect is unrelated to neuronal firing frequency. The data support the hypothesis that serotonin release is proportionate to intracellular serotonin levels. Author

A93-32124* National Aeronautics and Space Administration, Washington, DC.
LEARNING ABOUT PRIMATES' LEARNING, LANGUAGE, AND COGNITION
DUANE M. RUMBAUGH (Georgia State Univ., Atlanta; Yerkes Regional Primate Research Center, Decatur) *In* The undaunted psychologist: Adventures in research Philadelphia, PA Temple University Press 1992 p. 90-109. Research supported by

NSF, NIH, NASA, and Georgia State Univ refs
Copyright

Results are presented of many years of research on the methods of teaching primates the language and cognitive skills which were long considered to be unteachable to particular species of primates. It was found that chimpanzee subjects could not only learn a number of 'stock sentences' but to use them in variations and several combinations for the purpose of solving various problems. Apes placed in different rooms could be taught to communicate via computer, and collaborate with each other on doing specific tasks. Contrary to expectations, young rhesus monkeys proved to be able to learn as much as the chimpanzee species. AIAA

A93-32125
PERSISTENT BLOCKADE OF POTASSIUM-EVOKED SEROTONIN RELEASE FROM RAT FRONTOCORTICAL TERMINALS AFTER FLUOXETINE ADMINISTRATION
A. M. GARDIER and R. J. WURTMAN (MIT, Cambridge, MA) Brain Research (ISSN 0006-8993) vol. 540 1991 p. 325-330. Research supported by Center for Brain Sciences and Metabolism Charitable Trust refs
Copyright

The effects of chronic drug treatments on evoked serotonin release were examined by locally applying a potassium chloride solution to the serotoninergic nerve terminals of rats. Data obtained suggest that long-term changes in brain serotonin dynamics after high doses of dexfenfluramine or fluoxetine are related to the drug's mechanisms of action, specifically their blockade of 5-HT reuptake. AIAA

A93-32243* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SINGLE PARTICLE EFFECTS, BIOSTACK, AND RISK EVALUATION - STUDIES ON THE RADIATION RISK FROM GALACTIC COSMIC RAYS [EINZELTEILCHENEFFEKTE, BIOSTACK UND RISIKOABSCHAETZUNG - UNTERSUCHUNGEN ZUM STRAHLENRISIKO DURCH GALAKTISCHE KOSMISCHE STRAHLUNG]
STANLEY B. CURTIS (Lawrence Berkeley Lab., Berkeley, CA) DLR-Nachrichten (ISSN 0937-0420) no. 70 Feb. 1993 p. 25-29. Translation. In German.
(Contract NASA ORDER T-9310-R)
Copyright

The possible health risks posed by Galactic cosmic rays, especially the possible heightened cancer risk, are examined. The results of the Biostack studies of the biological effects of high-energy cosmic rays are discussed. The biological mechanisms involved in possible harm due to cosmic rays are considered. AIAA

A93-32651* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TESTING PRIMATES WITH JOYSTICK-BASED AUTOMATED APPARATUS - LESSONS FROM THE LANGUAGE RESEARCH CENTER'S COMPUTERIZED TEST SYSTEM
DAVID A. WASHBURN and DUANE M. RUMBAUGH (Georgia State Univ., Atlanta) Behavior Research Methods, Instruments, and Computers (ISSN 0743-3838) vol. 24, no. 2 1992 p. 157-164. Research supported by Georgia State Univ. refs
(Contract NAG2-438; NIH-HD-06016)
Copyright

Nonhuman primates provide useful models for studying a variety of medical, biological, and behavioral topics. Four years of joystick-based automated testing of monkeys using the Language Research Center's Computerized Test System (LRC-CTS) are examined to derive hints and principles for comparable testing with other species - including humans. The results of multiple parametric studies are reviewed, and reliability data are presented to reveal the surprises and pitfalls associated with video-task testing of performance. Author

A93-32652* National Aeronautics and Space Administration. *Ames Research Center, Moffett Field, CA.*
ANALYZING THE PATH OF RESPONDING IN MAZE-SOLVING AND OTHER TASKS
DAVID A. WASHBURN (Georgia State Univ., Atlanta) Behavior Research Methods, Instruments, and Computers (ISSN 0743-3838) vol. 24, no. 2 1992 p. 248-252. Research supported by Georgia State Univ. refs
(Contract NAG2-438; NIH-HD-06016)
Copyright

Response time and accuracy are sensitive measures of overall performance but may mask underlying response strategies. For example, analysis of latency and accuracy measures produced in a computerized-maze task does not reveal whether rhesus monkeys really 'solve a maze' or simply move as much as is possible toward the target, negotiating barriers through trial and error as they encounter them. Regression procedures are described for analyzing response path against several hypothetical response curves, and analyses of response path for rhesus monkeys' performance on the computerized MAZE task are presented as an illustration. The data suggest that rhesus monkeys do invoke a response strategy of solving the maze, because the observed response topography is significantly associated with the optimal path of responding. Many experimental paradigms should similarly benefit from analysis of the response paths that subjects exhibit. Author

A93-32670
FIRST SKULLS OF THE EARLY EOCENE PRIMATE SHOSHONIUS COOPERI AND THE ANTHROPOID-TARSIER DICHOTOMY
K. C. BEARD, LEONARD KRISHTALKA (Carnegie Museum of Natural History, Pittsburgh, PA), and RICHARD K. STUCKY (Denver Museum of Natural History, CO) Nature (ISSN 0028-0836) vol. 349, no. 6304 Jan. 3, 1991 p. 64-67. Research supported by NSF and Carnegie Museum of Natural History refs
Copyright

The anatomy of four skulls of the early Eocene omomyid Shoshonius cooperi (the first cranial material recovered for this genus) was examined in detail. The results suggest that Shoshonius cooperi shares a more recent common ancestry with Tarsius than do either anthropoids or other Eocene omomyids for which cranial anatomy is known. AIAA

A93-32749* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MECHANICALLY INDUCED ALTERATIONS IN CULTURED SKELETAL MUSCLE GROWTH
H. H. VANDENBURGH, S. HATFALUDY, P. KARLISCH, and J. SHANSKY (Brown Univ.; Miriam Hospital, Providence, RI) Journal of Biomechanics (ISSN 0021-9290) vol. 24, Supplement 1 1991 p. 91-99. Research supported by Miriam Foundation refs
(Contract NIH-AR-36266; NIH-AR-39998; NIH-RR-05818; NAG2-414)
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Model systems are available for mechanically stimulating *cultured skeletal muscle cells by passive tensile forces which* simulate those found in vivo. When applied to embryonic muscle cells in vitro these forces induce tissue organogenesis, metabolic adaptations, and muscle cell growth. The mechanical stimulation of muscle cell growth correlates with stretch-induced increases in the efflux of prostaglandins PGE2 and PGF2(alpha) in a time and frequency dependent manner. These prostaglandins act as mechanical 'second messengers' regulating skeletal muscle protein turnover rates. Since they also effect bone remodelling in response to tissue loading and unloading, secreted prostaglandins may serve as paracrine growth factors, coordinating the growth rates of muscle and bone in response to external mechanical forces. Cell culture model systems will supplement other models in understanding mechanical transduction processes at the molecular level. Author

A93-32773* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LINEAR VESTIBULOOCULAR REFLEX DURING MOTION ALONG AXES BETWEEN NASOOCCIPITAL AND INTERAURAL
DAVID L. TOMKO (NASA, Ames Research Center, Moffett Field; Stanford Univ., Medical Center, CA) and GARY D. PAIGE (Rochester Univ., NY) New York Academy of Sciences, Annals (ISSN 0077-8923) vol. 656 May 22, 1992 p. 233-241. refs
Copyright

Linear vestibuloocular reflexes (LVORs), which stabilize retinal images by producing e e movements to compensate for linear head motion, are of two types: (1) responses to head tilt, which work primarily at low frequencies; and (2) responses to head translation, which act at higher frequencies. This work tested the hypothesis that reflexive eye movements would follow the same kinematics relative to the motion axis regardless of head orientation relative to linear motion. The experiments consisted of recording horizontal and vertical eye movements in squirrel monkeys during linear oscillations at 5 Hz along the head's nasooccipital (NO) axis and along axes lying within +/- 30 deg of the NO axis. It was found that LVORs followed the same kinematics regardless of the eye position in the head or the head orientation relative to motion. AIAA

A93-32850 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
STRUCTURE OF A HUMAN MONOCLONAL ANTIBODY FAB FRAGMENT AGAINST GP41 OF HUMAN IMMUNODEFICIENCY VIRUS TYPE 1
XIAO M. HE (NASA, Marshall Space Flight Center, Huntsville, AL), FLORIAN RUEKER (Univ. of Agriculture and Forestry, Vienna, Austria), ELENA CASALE, and DANIEL C. CARTER (NASA, Marshall Space Flight Center, Huntsville, AL) National Academy of Sciences, Proceedings (ISSN 0027-8424) vol. 89 Aug. 1992 p. 7154-7158. refs
(Contract RTOP 674-23-08-17; FFWF PROJECT P-7556-BIO)
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The three-dimensional structure of a human monoclonal antibody (Fab), which binds specifically to a major epitope of the transmembrane protein gp41 of the human immunodeficiency virus type 1, has been determined by crystallographic methods to a resolution of 2.7 A. It has been previously determined that this antibody recognizes the epitope SGKLICTTAVPWNAS, belongs to the subclass IgG1 (kappa), and exhibits antibody-dependent cellular cytotoxicity. The quaternary structure of the Fab is in an extended conformation with an elbow bend angle between the constant and variable domains of 175 deg. Structurally, four of the hypervariable loops can be classified according to previously recognized canonical structures. The third hypervariable loops of the heavy (H3) and light chain (L3) are structurally distinct. Hypervariable loop H3, residues 102H-109H, is unusually extended from the surface. The complementarity-determining region forms a hydrophobic binding pocket that is created primarily from hypervariable loops L3, H3, and H2. Author

A93-33026* National Aeronautics and Space Administration, Washington, DC.
REVISION OF THE WIND RIVER FAUNAS, EARLY EOCENE OF CENTRAL WYOMING. X - BUNOPHORUS (MAMMALIA, ARTIODACTYLA)
RICHARD K. STUCKY and LEONARD KRISHTALKA (Denver Museum of Natural History, CO) Carnegie Museum of Natural History, Annals (ISSN 0097-4463) vol. 59, no. 2 June 8, 1990 p. 149-171. Research supported by Carnegie Museum of Natural History refs
(Contract NSF BSR-84-02051; NSF BSR-87-09242; NAGW-949; NAGW-1803)
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Research on the holotypes and large collections of the species of Wasatchia and Bunophorus is reviewed. It is concluded that Bunophorus is a senior synonym of Wasatchia and includes six valid species, namely, B. etsagicus, B. grangeri, B. pattersoni, B. macropternus, B. sinclairi, and B. robustus. B. sinclairi includes two penecontemporaneous geographic variants: B.s. sinclairi from the Wind River, Piceance and Green River basins, and B.s. robinsoni, n. ssp., from the Huerfano Basin. AIAA

A93-33027* National Aeronautics and Space Administration, Washington, DC.
ALANINE INCREASES BLOOD PRESSURE DURING HYPOTENSION
L. A. CONLAY (MIT, Cambridge; Massachusetts General Hospital; Harvard Medical School, Boston), T. J. MAHER (MIT, Cambridge; Massachusetts College of Pharmacy and Allied Health Sciences, Boston), and R. J. WURTMAN (MIT, Cambridge, MA) Pharmacology & Toxicology (ISSN 0901-9928) vol. 66 1990 p. 415, 416. Research supported by NASA and USAF refs
(Contract NIH-R23-3026)
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The effect of L-alanine administration on blood pressure (BP) during haemorrhagic shock was investigated using anesthetized rats whose left carotid arteries were cannulated for BP measurement, blood removal, and drug administration. It was found that L-alanine, in doses of 10, 25, 50, 100, and 200 mg/kg, increased the systolic BP of hypotensive rats by 38 to 80 percent (while 100 mg/kg pyruvate increased BP by only 9.4 mmhg, not significantly different from saline). The results suggest that L-alanine might influence cardiovascular function. AIAA

A93-33028
RELATIONSHIP BETWEEN PITUITARY ACTH CONTENT AND HYPOTHALAMIC CATECHOLAMINES IN THE RAT
H. LEHNERT, J. BEYER (III Medical Univ. Hospital, Mainz, Germany), D. K. REINSTEIN, U. I. RICHARDSON, and R. J. WURTMAN (MIT, Cambridge, MA) Research in Experimental Medicine (ISSN 0300-9130) vol. 189 1989 p. 289-293. refs
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Hypothalamic concentrations of epinephrine and norepinephrine were determined in rats following 6-hydroxydopamine lesions of the locus coeruleus and subcoeruleus system and following sham-operation. These concentrations were correlated with pituitary ACTH content. While the lesion procedure did not have a major effect on hypothalamic monoamine levels, we were able to demonstrate a strong negative correlation between hypothalamic epinephrine and pituitary ACTII content independent of the experimental condition. Only a weak negative correlation was observed for hypothalamic norepinephrine and pituitary ACTII. Our recent and previous data suggest a tonic and phasic inhibition of ACTH release by hypothalamic monoamines. Author

A93-33029
FACILITATION OF LEVODOPA-INDUCED DYSKINESIAS BY DIETARY CARBOHYDRATES
RICHARD WURTMAN, BENJAMIN CABALLERO (MIT, Cambridge, MA), and EDWIN SALZMAN (Harvard Univ., Boston, MA) New England Journal of Medicine (ISSN 0028-4793) vol. 319 1988 p. 1288, 1289. refs
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The cause of the variability of the response of patients affected by Parkinson's disease, when on a regimen of levodopa or levodopa with a decarboxylase inhibitor, was investigated, with particular attention given to the possible involvement of large neutral amino acids (LNAA). In the experiment, plasma levels of dopa and LNAA were examined, along with the clinical responses to levodopa, in a subject consuming test meals designed to alter plasma levels of LNAA. The findings indicated that a high-carbohydrate meal may trigger symptoms of dopa toxicity in patients receiving this drug. This effect does not depend on plasma levels of dopa, but rather on the plasma ratio of dopa to LNAA, which rises markedly after carbohydrate ingestion. AIAA

A93-33030* National Aeronautics and Space Administration, Washington, DC.
MELATONIN CONCENTRATIONS IN THE SUDDEN INFANT DEATH SYNDROME
W. Q. STURNER (Office of State Medical Examiners; Brown Univ.,

Providence, RI), H. J. LYNCH, M. H. DENG, R. E. GLEASON, and R. J. WURTMAN (MIT, Cambridge, MA) Forensic Science International (ISSN 0379-0738) vol. 45 1990 p. 171-180. Research supported by NASA refs
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The melatonin levels in various body fluids of the sudden infant death syndrome (SIDS) infants are compared with those of infants of comparable age who died of other causes to examine a possible relationship between pineal function and SIDS. After adjusting for age differences, cerebrospinal fluid melatonin levels are found to be significantly lower in the SIDS infants. It is suggested that diminished melatonin production may be characteristic of SIDS and could represent an impairment in the maturation of physiologic circadian organization. AIAA

A93-33031* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EFFECTS OF DIETARY AMINO ACIDS, CARBOHYDRATES, AND CHOLINE ON NEUROTRANSMITTER SYNTHESIS
RICHARD J. WURTMAN (MIT, Cambridge, MA) Mount Sinai Journal of Medicine (ISSN 0027-2507) vol. 55, no. 1 Jan. 1988 p. 75-86. refs
(Contract NIH-NS-21231; NIH-MH-28783; AF-AFOSR-83-0366; NAG2-210; NIH-RR-00088-24)
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The ability of a meal to increase or decrease brain neurotransmitter synthesis has been studied. It is concluded that brain serotonin synthesis is directly controlled by the proportions of carbohydrate to protein in meals and snacks that increase or decrease brain tryptophan levels, thereby changing the substrate saturation of tryptophan hydroxylase and the rate of serotonin synthesis. The ability of serotoninergic neurons to have their output coupled to dietary macronutrients enables them to function as sensors of peripheral metabolism, and to subserve an important role in the control of appetite. The robust and selective responses of catecholaminergic and cholinergic neurons to supplemental tyrosine and choline suggest that these compounds may become useful as a new type of drug for treating deseases or conditions in which adequate quantities of the transmitter would otherwise be unavailable. AIAA

A93-33033* National Aeronautics and Space Administration, Washington, DC.
EFFECTS OF THEIR NUTRIENT PRECURSORS ON THE SYNTHESIS AND RELEASE OF SEROTONIN, THE CATECHOLAMINES, AND ACETYLCHOLINE - IMPLICATIONS FOR BEHAVIORAL DISORDERS
RICHARD J. WURTMAN (MIT, Cambridge, MA) Clinical Neuropharmacology (ISSN 0362-5664) vol. 11, Supplement 1 1988 p. S187-S193. Research supported by NASA and USAF refs
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Authentic foods affect brain serotonin synthesis by modifying brain tryptophan levels, carbohydrates increasing and proteins decreasing these levels. The carbohydrate-induced rise in brain serotonin tends to diminish the likelihood that one carbohydrate-rich, protein-poor meal or snack will be followed by another. This mechanism is apparently disturbed in carbohydrate-craving obesity, which may explain why this syndrome responds well to d-fenfluramine, a serotoninergic drug. Pure nutrients like tyrosine or choline can also affect the rates at which their neurotransmitter products, the catecholamines and acetylcholine, are synthesized in and released from nerve terminals, suggesting that these compounds may find uses as drugs. Author

A93-33035* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPARATIVE ASSESSMENT OF PSYCHOMOTOR PERFORMANCE - TARGET PREDICTION BY HUMANS AND MACAQUES (MACACA MULATTA)
DAVID A. WASHBURN and DUANE M. RUMBAUGH (Georgia State Univ., Atlanta) Journal of Experimental Psychology: General (ISSN 0096-3445) vol. 121, no. 3 1992 p. 305-312. Research supported by Georgia State Univ. refs
(Contract NAG2-438; NIH-HD-06016)
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Although nonhuman primates such as rhesus monkeys (Macaca mulatta) have been useful models of many aspects of cognition and performance, it has been argued that, unlike humans, they may lack the capacity to respond as predictor-operators. Data from the present series of experiments undermine this claim, suggesting instead a continuity of predictive competency between humans and nonhuman primates. A prediction coefficient was devised to examine the degree to which each subject's response path approximated the optimal predictive strategy. Whereas human subjects (N= 30) generally predicted more accurately, rhesus monkeys (N= 10) also significantly anticipated the movements of the target in all conditions. It appears that humans and rhesus monkeys both exhibit the capacity to respond to where a stimulus is going. Author (revised)

A93-33036* National Aeronautics and Space Administration, Washington, DC.
THE PINEAL GLAND - ITS POSSIBLE ROLES IN HUMAN REPRODUCTION
AMNON BRZEZINSKI and RICHARD J. WURTMAN (MIT, Cambridge, MA) Obstetrical and Gynecological Survey (ISSN 0029-7828) vol. 43, no. 4 1988 p. 197-207. Research supported by NASA, USAF, and Center for Brain Sciences and Metabolism Charitable Trust refs
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The paper discusses the role of the pineal gland in controlling mammalian reproduction, with particular attention given to the role of melatonin in polyestrus mammals, like humans and laboratory rodents. Evidence is cited indicating the influence of melatonin production and blood content on the age of puberty, the timing of the ovulatory cycle, gonadal steriodogenesis, and patterns of reproductive behavior. It is suggested that abnormal patterns of melatonin might be associated with amenorrhea, anovulation, unexplained infertility, premature menopause, and habitual abortions. AIAA

A93-33038* National Aeronautics and Space Administration, Washington, DC.
TYROSINE - EFFECTS ON CATECHOLAMINE RELEASE
IAN N. ACWORTH, MATTHEW J. DURING, and RICHARD J. WURTMAN (MIT, Cambridge, MA) Brain Research Bulletin (ISSN 0361-9320) vol. 21 1988 p. 473-477. Research supported by USAF, Center for Brain Sciences and Metabolism Charitable Trust, and NASA refs
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Tyrosine administration elevates striatal levels of dopamine metabolites in animals given treatments that accelerate nigrostriatal firing, but not in untreated rats. We examined the possibility that the amino acid might actually enhance dopamine release in untreated animals, but that the technique of measuring striatal dopamine metabolism was too insensitive to demonstrate such an effect. Dopamine release was assessed directly, using brain microdialysis of striatal extracellular fluid. Tyrosine administration (50-200 mg/kg IP) did indeed cause a dose related increase in extracellular fluid dopamine levels with minor elevations in levels of DOPAC and HVA, its major metabolites, which were not dose-related. The rise in dopamine was short-lived, suggesting that receptor-mediated feedback mechanisms responded to the increased dopamine release by diminishing neuronal firing or sensitivity to tyrosine. These observations indicate that measurement of changes in striatal DOPAC and HVA, if negative, need not rule out increases in nigrostriatal dopamine release. Author

A93-33043* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MECHANICAL FORCES AND THEIR SECOND MESSENGERS IN STIMULATING CELL GROWTH IN VITRO
HERMAN H. VANDENBURGH (Brown Univ.; Miriam Hospital,

Providence, RI) American Journal of Physiology: Regulatory, Integrative and Comparative Physiology (ISSN 0363-6119) vol. 31 1992 p. R350-R355. refs
(Contract NIH-AR-39998; NAG2-414)
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Mechanical forces play an important role in modulating the growth of a number of different tissues including skeletal muscle, smooth muscle, cardiac muscle, bone, endothelium, epithelium, and lung. As interest increases in the molecular mechanisms by which mechanical forces are transduced into growth alterations, model systems are being developed to study these processes in tissue culture. This paper reviews the current methods available for mechanically stimulating tissue cultured cells. It then outlines some of the putative 'mechanogenic' second messengers involved in altering cell growth. Not surprisingly, many mechanogenic second messengers are the same as those involved in growth factor-induced cell growth. It is hypothesized that from an evolutionary standpoint, some second messenger systems may have initially evolved for unicellular organisms to respond to physical forces such as gravity and mechanical perturbation in their environment. As multicellular organisms came into existence, they appropriated these mechanogenic second messenger cascades for cellular regulation by growth factors. Author

A93-33045* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPUTER-AIDED MECHANOGENESIS OF SKELETAL MUSCLE ORGANS FROM SINGLE CELLS IN VITRO
HERMAN H. VANDERBURGH (Brown Univ.; Miriam Hospital, Providence, RI), SOMPORN SWASDISON (Alabama Univ., Birmingham), and PATRICIA KARLISCH (Brown Univ.; Miriam Hospital, Providence, RI) FASEB Journal (ISSN 0892-6638) vol. 5 Oct. 1991 p. 2860-2867. Previously announced in STAR as N90-28959 refs
(Contract NIH-AR-36266; NIH-AR-39998; NIH-RR-05818; NIH-AR-37984; NAG2-414)
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Complex mechanical forces generated in the growing embryo play an important role in organogenesis. Computerized application of similar forces to differentiating skeletal muscle myoblasts in vitro generate three dimensional artificial muscle organs. These organs contain parallel networks of long unbranched myofibers organized into fascicle-like structures. Tendon development is initiated and the muscles are capable of performing directed, functional work. Kinetically engineered organs provide a new method for studying the growth and development of normal and diseased skeletal muscle. Author

N93-22622*# National Aeronautics and Space Administration, Washington, DC.
LIFE SCIENCES UTILIZATION OF SPACE STATION FREEDOM
LAWRENCE P. CHAMBERS *In its* Space Station Freedom Utilization Conference p 211-220 1992
Avail: CASI HC A02/MF A04

Space Station Freedom will provide the United States' first permanently manned laboratory in space. It will allow, for the first time, long term systematic life sciences investigations in microgravity. This presentation provides a top-level overview of the planned utilization of Space Station Freedom by NASA's Life Sciences Division. The historical drivers for conducting life sciences research on a permanently manned laboratory in space as well as the advantages that a space station platform provides for life sciences research are discussed. This background information leads into a description of NASA's strategy for having a fully operational International Life Sciences Research Facility by the year 2000. Achieving this capability requires the development of the five discipline focused 'common core' facilities. Once developed, these facilities will be brought to the space station during the Man-Tended Capability phase, checked out and brought into operation. Their delivery must be integrated with the Space Station Freedom manifest. At the beginning of Permanent Manned Capability, the infrastructure is expected to be completed and the Life Sciences Division's SSF Program will become fully operational. A brief facility description, anticipated launch date and a focused objective is provided for each of the life sciences facilities, including the Biomedical Monitoring and Countermeasures (BMAC) Facility, Gravitational Biology Facility (GBF), Gas Grain Simulation Facility (GGSF), Centrifuge Facility (CF), and Controlled Ecological Life Support System (CELSS) Test Facility. In addition, hardware developed by other NASA organizations and the SSF International Partners for an International Life Sciences Research Facility is also discussed. Author (revised)

N93-22623*# National Aeronautics and Space Administration, Washington, DC.
LIFE SCIENCES RECRUITMENT OBJECTIVES
J. RICHARD KEEFE *In its* Space Station Freedom Utilization Conference p 221-233 1992
Avail: CASI HC A03/MF A04

The goals of the Life Sciences Division of the Office of Space Sciences and Application are to ensure the health, well being and productivity of humans in space and to acquire fundamental scientific knowledge in space life sciences. With these goals in mind Space Station Freedom represents substantial opportunities and significant challenges to the Life Sciences Division. For the first time it will be possible to replicate experimental data from a variety of simultaneously exposed species with appropriate controls and real-time analytical capabilities over extended periods of time. At the same time, a system for monitoring and ameliorating the physiological adaptations that occur in humans subjected to extended space flight must be evolved to provide the continuing operational support to the SSF crew. To meet its goals, and take advantage of the opportunities and overcome the challenges presented by Space Station Freedom, the Life Sciences Division is developing a suite of discipline-focused sequence. The research phase of the Life Sciences Space Station Freedom Program will commence with the utilization flights following the deployment of the U.S. laboratory module and achievement of Man Tended Capability. Investigators that want the Life Sciences Division to sponsor their experiment on SSF can do so in one of three ways: submitting a proposal in response to a NASA Research Announcement (NRA), submitting a proposal in response to an Announcement of Opportunity (AO), or submitting an unsolicited proposal. The scientific merit of all proposals will be evaluated by peer review panels. Proposals will also be evaluated based on relevance to NASA's missions and on the results of an Engineering and Cost Analyses. The Life Sciences Division expects that the majority of its funding opportunities will be announced through NRA's. It is anticipated that the first NRA will be released approximately three years before first element launch (currently scheduled for late 1995). Subsequent NRA's will be released on a rotating two year cycle. Author

N93-22624*# National Aeronautics and Space Administration, Washington, DC.
BIOMEDICAL MONITORING AND COUNTERMEASURES FACILITY
DONALD F. STEWART *In its* Space Station Freedom Utilization Conference p 235-249 1992
Avail: CASI HC A03/MF A04

The Space Station Freedom Program (SSFP) represents the transition within the US Space program from the 'heroic' era of space flight (characterized most vividly by the Mercury and Apollo programs) to an epoch characterized by routine access to the space environment. In this new era, the unique characteristics of the microgravity environment will enable new types of research activities, primarily in the life sciences, materials science, and biotechnology fields. In addition to its role as a'microgravity science laboratory,' Space Station Freedom (SSF) constitutes the operational platform on which the knowledge and skills needed to continue our exploration of space will be acquired. In the area of spacecraft operations, these skills include the ability to assemble, operate, and maintain large structures in space. In the area of crew operations, the potentially harmful effects of extended exposure to microgravity must be understood in order to keep the crew mission capable. To achieve this goal, the complex process

of physiological deconditioning must be monitored, and countermeasures utilized as needed to keep the individual crew members within acceptable physiological limits. The countermeasures program under development for the SSF Program is titled the Biomedical Monitoring and Countermeasures (BMAC) program. As implied by the name, this activity has two primary products, a biomedical monitoring element and a countermeasures development effort. The program is a critical path element in the overall SSF Program, and should be considered an essential element of operations on board the space station. It is readily apparent that the capability to both protect and optimize the health and performance of the human operators on board SSF will be a critical element in the overall success of the SSFP. Previous experience within the Russian space program has demonstrated that the time required for countermeasures on extended missions can become a monumental operational burden. Therefore, one of the primary objectives of the countermeasures development activity will be to design and implement countermeasures which are significantly more effective than the existing generation. Other primary objectives include the following: to set health and human performance standards for all mission phases; to determine critical issues that affect performance or return to flight status; to develop and implement monitoring systems to follow health and performance status; and to understand risk, and balance the resource costs of countermeasures vs. the benefit gained.

Author (revised)

N93-22625*# General Electric Co., Huntsville, AL. Government Services.

GRAVITATIONAL BIOLOGY FACILITY ON SPACE STATION: MEETING THE NEEDS OF SPACE BIOLOGY

KATHERINE ALLEN and CHARLES WADE *In* NASA, Washington, Space Station Freedom Utilization Conference p 251-259 1992

Avail: CASI HC A02/MF A04

The Gravitational Biology Facility (GBF) is a set of generic laboratory equipment needed to conduct research on Space Station Freedom (SSF), focusing on Space Biology Program science (Cell and Developmental Biology and Plant Biology). The GBF will be functional from the earliest utilization flights through the permanent manned phase. Gravitational biology research will also make use of other Life Sciences equipment on the space station as well as existing equipment developed for the space shuttle. The facility equipment will be developed based on requirements derived from experiments proposed by the scientific community to address critical questions in the Space Biology Program. This requires that the facility have the ability to house a wide variety of species, various methods of observation, and numerous methods of sample collection, preservation, and storage. The selection of the equipment will be done by the members of a scientific working group (5 members representing cell biology, 6 developmental biology, and 6 plant biology) who also provide requirements to design engineers to ensure that the equipment will meet scientific needs. All equipment will undergo extensive ground based experimental validation studies by various investigators addressing a variety of experimental questions. Equipment will be designed to be adaptable to other space platforms. The theme of the Gravitational Biology Facility effort is to provide optimal and reliable equipment to answer the critical questions in Space Biology as to the effects of gravity on living systems. Author (revised)

N93-22629*# Omega Aerospace, Inc., Virginia Beach, VA.

AN ON-ORBIT VIEWPOINT OF LIFE SCIENCES RESEARCH Abstract Only

BYRON K. LICHTENBERG *In* NASA, Washington, Space Station Freedom Utilization Conference p 291 1992

Avail: CASI HC A01/MF A04

As a Payload Specialist and a life science researcher, I want to present several issues that impact life science research in space. During early space station operations, life science and other experiments will be conducted in a time-critical manner and there will be the added duties of both space shuttle and space station systems operation (and the concomittent training overhead). Life sciences research is different from other science research done in space because the crew is involved both as an operator and as a subject. There is a need for pre- and post-flight data collection as well as in flight data collection. It is imperative that the life science researcher incorporate the crew members into their team early enough in the training cycle to fully explain the science and to make the crew aware of the importance and sensitivities of the experiment. During the pre-flight phase, the crew is incredibly busy with a myriad of duties. Therefore, it is difficult to get 'pristine' subjects for the baseline data collection. There are also circadian shifts, travel, and late nights to confound the data. During this time it is imperative that the researcher develop, along with the crew, a realistic estimate of crew-time required for their experiment. In flight issues that affect the researcher are the additional activities of the crew, the stresses inherent in space flight, and the difficulty of getting early in-flight data. During SSF activities, the first day or two will be taken up with rendezvous and docking. Other issues are the small number of subjects on any given flight, the importance of complete and concise procedures, and the vagaries of on-board data collection. Post flight, the crew is tired and experiences a 'relaxation.' This along with circadian shifts and rapid re-adaptation to 1-g make immediate post-flight data collection difficult. Finally, the blending of operational medicine and research can result in either competition for resources (crew time, etc.) or influence on the physiological state of the crew. However, the unique opportunity to conduct research in an environment that cannot be duplicated on Earth outweighs the 'challenges' that exist for space life researchers. Author (revised)

N93-22649*# Pennsylvania State Univ., University Park. Center for Cell Research.

COMMERCIAL OPPORTUNITIES IN BIOSEPARATIONS AND PHYSIOLOGICAL TESTING ABOARD SPACE STATION FREEDOM

W. C. HYMER *In* NASA, Washington, Space Station Freedom Utilization Conference p 553-566 1992

Avail: CASI HC A03/MF A04

The Center for Cell Research (CCR) is a NASA Center for the Commercial Development of Space which has as its main goal encouraging industry-driven biomedical/biotechnology space projects. Space Station Freedom (SSF) will provide long duration, crew-tended microgravity environments which will enhance the opportunities for commercial biomedical/biotechnology projects in bioseparations and physiological testing. The CCR bioseparations program, known as USCEPS (for United States Commercial Electrophoresis Program in Space), is developing access for American industry to continuous-flow electrophoresis aboard SSF. In space, considerable scale-up of continuous free-flow electrophoresis is possible for cells, sub cellular particles, proteins, growth factors, and other biological products. The lack of sedemination and buoyancy-driven convection flow enhances purity of separations and the amount of material processed/time. Through the CCR's physiological testing program, commercial organizations will have access aboard SSF to physiological systems experiments (PSE's); the Penn State Biomodule; and telemicroscopy. Physiological systems experiments involve the use of live animals for pharmaceutical product testing and discovery research. The Penn State Biomodule is a computer-controlled mini lab useful for projects involving live cells or tissues and macro molecular assembly studies, including protein crystallization. Telemicroscopy will enable staff on Earth to manipulate and monitor microscopic specimens on SSF for product development and discovery research or for medical diagnosis of astronaut health problems. Space-based product processing, testing, development, and discovery research using USCEPS and CCR's physiological testing program offer new routes to improved health on Earth. Direct crew involvement-in biomedical/biotechnology projects aboard SSF will enable better experimental outcomes. The current data base shows that there is reason for considerable optimism regarding what the CCDS program and the biomedical/biotechnology industry can expect to gain from a permanent manned presence in space.

Author (revised)

N93-22651*# Alabama Univ., Huntsville. Consortium for Materials Development in Space.
MATERIALS DISPERSION AND BIODYNAMICS PROJECT RESEARCH
MARIAN L. LEWIS *In* NASA, Washington, Space Station Freedom Utilization Conference p 575-588 1992
Avail: CASI HC A03/MF A04

The Materials Dispersion and Biodynamics Project (MDBP) focuses on dispersion and mixing of various biological materials and the dynamics of cell-to-cell communication and intracellular molecular trafficking in microgravity. Research activities encompass biomedical applications, basic cell biology, biotechnology (products from cells), protein crystal development, ecological life support systems (involving algae and bacteria), drug delivery (microencapsulation), biofilm deposition by living organisms, and hardware development to support living cells on Space Station Freedom (SSF). Project goals are to expand the existing microgravity science database through experiments on sounding rockets, the Shuttle, and COMET program orbiters and to evolve,through current database acquisition and feasibility testing, to more mature and larger-scale commercial operations on SSF. Maximized utilization of SSF for these science applications will mean that service companies will have a role in providing equipment for use by a number of different customers. An example of a potential forerunner of such a service for SSF is the Materials Dispersion Apparatus (MDA) 'mini lab' of Instrumentation Technology Associates, Inc. (ITA) in use on the Shuttle for the Commercial MDAITA Experiments (CMIX) Project. The MDA wells provide the capability for a number of investigators to perform mixing and bioprocessing experiments in space. In the area of human adaptation to microgravity, a significant database has been obtained over the past three decades. Some low-g effects are similar to Earth-based disorders (anemia, osteoporosis, neuromuscular diseases, and immune system disorders). As new information targets potential profit-making processes, services and products from microgravity, commercial space ventures are expected to expand accordingly. Cooperative CCDS research in the above mentioned areas is essential for maturing SSF biotechnology and to ensure U.S. leadership in space technology. Currently, the MDBP conducts collaborative research with investigators at the Rockefeller University, National Cancer Institute, and the Universities of California, Arizona, and Alabama in Birmingham. The growing database from these collaborations provides fundamental information applicable to development of cell products, manipulation of immune cell response, bone cell growth and mineralization, and other processes altered by low-gravity. Contacts with biotechnology and biopharmaceutical companies are being increased to reach uninformed potential SSF users, provide access through the CMDS to interested users for feasibility studies, and to continue active involvement of current participants. We encourage and actively seek participation of private sector companies, and university and government researchers interested in biopharmaceuticals, hardware development and fundamental research in microgravity. Author (revised)

N93-22800*# California Univ., Berkeley. Interdisciplinary Studies Center.
MICROMOTIONAL STUDIES OF UTRICULAR AND CANAL AFFERENTS Final Technical Report, 1 Jan. 1987 - 31 Dec. 1989
EDWIN R. LEWIS 31 Dec. 1989 4 p
(Contract NAG2-448)
(NASA-CR-192703; NAS 1.26:192703) Avail: CASI HC A01/MF A01

The long-range goal of this research was to refine our understanding of the sensitivity of the vestibular components of the ear to very-low-amplitude motion, especially, the role of gravity in this sensitivity. We focused on the American bullfrog--a common animal subject for vestibular sensory research. Our principal experimental method was to apply precise, sinusoidal microrotational stimuli to an anesthetized animal subject, to record the resulting responses in an individual vestibular nerve fiber from the intact ear, and to use intracellular dye to trace the fiber and thus identify the vestibular sensor that gave rise to it. In this way, we were able to identify specific micromotional sensitivities and to associate those sensitivities definitely with specific sensors. Furthermore, by recording from nerve fibers after they leave the intact inner-ear cavity, we were able to achieve these identifications without interrupting the delicate micromechanics of the inner ear. We were especially concerned with the relative roles of the utricle and the anterior semicircular canal in the sensing of microrotational motion of the head about horizontal axes, and with the role of gravity in mediating that sensing process in the utricle. The functional characterization of individual nerve fibers was accomplished with a conventional analytical tool, the cycle histogram, in which the nerve impulse rate was plotted against the phase of the sinusoidal stimulus. Author

N93-22913# Southwest Research Inst., San Antonio, TX.
EFFECTS OF 60-HZ ELECTRIC AND MAGNETIC FIELDS ON OPERANT AND SOCIAL BEHAVIOR AND ON NEUROENDOCTRINE SYSTEM OF NONHUMAN PRIMATES
W. R. ROGERS 22 Jan. 1993 11 p
(Contract DE-AC02-80RA-50219)
(DE93-007677; DOE/RA-50219/T27) Avail: CASI HC A03/MF A01

This series of experiments, using a well-characterized exposure facility and employing a variety of control procedures to study behavior and the neuroendoctrine system of nonhuman primates, does not provide any evidence that exposure to power-frequency electric fields, or electric and magnetic fields in combination, for 12 hours per day for six weeks produces any deleterious effects in young-adult males. The primate experiments summarized here confirm the general conclusion indicated by experiments with rodents; although biological and behavioral changes can occur, there are no clear results establishing the occurrence of adverse effects in experiments involving relatively short-term exposure to environmentally-relevant electric or magnetic fields. Given the general agreement of the primate and rodent results, conclusions from the laboratory animal studies therefore presumably generalize well to humans. DOE

N93-23068*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE. TRADE STUDIES, VOLUME 1
1 Jun. 1989 395 p Sponsored by NASA. Johnson Space Center
(NASA-CR-190989; NAS 1.26:190989) Avail: CASI HC A17/MF A04

The six studies which are addressed are entitled: Design Modularity and Commonality; Modification of Existing Hardware (COTS) vs. New Hardware Build Cost Analysis; Automation Cost vs. Crew Utilization; Hardware Miniaturization versus Cost; Space Station Freedom/Spacelab Modules Compatibility vs. Cost; and Prototype Utilization in the Development of Space Hardware. The product of these six studies was intended to provide a knowledge base and methodology that enables equipment produced for the Space Biology Initiative program to meet specific design and functional requirements in the most efficient and cost effective form consistent with overall mission integration parameters. Each study promulgates rules of thumb, formulas, and matrices that serves has a handbook for the use and guidance of designers and engineers in design, development, and procurement of Space Biology Initiative (SBI) hardware and software.

N93-23069*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 5: MODIFICATION OF EXISTING HARDWARE (COTS) VERSUS NEW HARDWARE BUILD COST ANALYSIS Final Report
L. NEAL JACKSON, JOHN CRENSHAW, SR., WILLIAM L. DAVIDSON (Eagle Engineering, Inc., Houston, TX.), CAROLYN BLACKNALL (Eagle Engineering, Inc., Houston, TX.), JAMES W. BILODEAU (Eagle Engineering, Inc., Houston, TX.), J. MICHAEL STOVAL (Eagle Engineering, Inc., Houston, TX.), and TERRY SUTTON (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 1 120 p 1 Jun. 1989

Prepared in cooperation with General Electric Co., Houston, TX
(Contract G966016-J45)
Avail: CASI HC A06/MF A04

The JSC Life Sciences Project Division has been directly supporting NASA Headquarters, Life Sciences Division, in the preparation of data from JSC and ARC to assist in defining the Space Biology Initiative (SBI). GE Government Services and Horizon Aerospace have provided contract support for the development and integration of review data, reports, presentations, and detailed supporting data. An SBI Definition (Non-Advocate) Review at NASA Headquarters, Code B, has been scheduled for the June-July 1989 time period. In a previous NASA Headquarters review, NASA determined that additional supporting data would be beneficial to determine the potential advantages in modifying commercial off-the-shelf (COTS) hardware for some SBI hardware items. In order to meet the demands of program implementation planning with the definition review in late spring of 1989, the definition trade study analysis must be adjusted in scope and schedule to be complete for the SBI Definition (Non-Advocate) Review. The relative costs of modifying existing commercial off-the-shelf (COTS) hardware is compared to fabricating new hardware. An historical basis for new build versus modifying COTS to meet current NMI specifications for manned space flight hardware is surveyed and identified. Selected SBI hardware are identified as potential candidates for off-the-shelf modification and statistical estimates on the relative cost of modifying COTS versus new build are provided. Author (revised)

N93-23070*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 1: AUTOMATION COSTS VERSUS CREW UTILIZATION Final Report
L. NEAL JACKSON, JOHN CRENSHAW, SR., R. N. HAMBRIGHT (Southwest Research Inst., Houston, TX.), A. NEDUNGADI (Southwest Research Inst., Houston, TX.), G. M. MCFAYDEN (Southwest Research Inst., Houston, TX.), and M. S. TSUCHIDA (Southwest Research Inst., Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 1 91 p 1 Jun. 1989 Prepared in cooperation with General Electric Co., Houston, TX
(Contract G966016-J45)
Avail: CASI HC A05/MF A04

A significant emphasis upon automation within the Space Biology Initiative hardware appears justified in order to conserve crew labor and crew training effort. Two generic forms of automation were identified: automation of data and information handling and decision making, and the automation of material handling, transfer, and processing. The use of automatic data acquisition, expert systems, robots, and machine vision will increase the volume of experiments and quality of results. The automation described may also influence efforts to miniaturize and modularize the large array of SBI hardware identified to date. The cost and benefit model developed appears to be a useful guideline for SBI equipment specifiers and designers. Additional refinements would enhance the validity of the model. Two NASA automation pilot programs, 'The Principal Investigator in a Box' and 'Rack Mounted Robots' were investigated and found to be quite appropriate for adaptation to the SBI program. There are other in-house NASA efforts that provide technology that may be appropriate for the SBI program. Important data is believed to exist in advanced medical labs throughout the U.S., Japan, and Europe. The information and data processing in medical analysis equipment is highly automated and future trends reveal continued progress in this area. However, automation of material handling and processing has progressed in a limited manner because the medical labs are not affected by the power and space constraints that Space Station medical equipment is faced with. Therefore, NASA's major emphasis in automation will require a lead effort in the automation of material handling to achieve optimal crew utilization.
Author (revised)

N93-23071*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 4: DESIGN MODULARITY AND COMMONALITY Final Report
L. NEAL JACKSON, JOHN CRENSHAW, SR., WILLIAM L. DAVIDSON (Eagle Engineering, Inc., Houston, TX.), FRANK J. HERBERT (Eagle Engineering, Inc., Houston, TX.), JAMES W. BILODEAU (Eagle Engineering, Inc., Houston, TX.), J. MICHAEL STOVAL (Eagle Engineering, Inc., Houston, TX.), and TERRY SUTTON (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 1 141 p 1 Jun. 1989 Prepared in cooperation with General Electric Co., Houston, TX
(Contract G966016-J45)
Avail: CASI HC A07/MF A04

The relative cost impacts (up or down) of developing Space Biology hardware using design modularity and commonality is studied. Recommendations for how the hardware development should be accomplished to meet optimum design modularity requirements for Life Science investigation hardware will be provided. In addition, the relative cost impacts of implementing commonality of hardware for all Space Biology hardware are defined. Cost analysis and supporting recommendations for levels of modularity and commonality are presented. A mathematical or statistical cost analysis method with the capability to support development of production design modularity and commonality impacts to parametric cost analysis is provided. Author (revised)

N93-23079*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE. TRADE STUDIES, VOLUME 2
1 Jun. 1989 366 p Sponsored by NASA. Johnson Space Center
(NASA-CR-190990; NAS 1.26:190990) Avail: CASI HC A16/MF A03

The six studies which are the subjects of this report are entitled: Design Modularity and Commonality; Modification of Existing Hardware (COTS) vs. New Hardware Build Cost Analysis; Automation Cost vs. Crew Utilization; Hardware Miniaturization versus Cost; Space Station Freedom/Spacelab Modules Compatibility vs. Cost; and Prototype Utilization in the Development of Space Hardware. The product of these six studies was intended to provide a knowledge base and methodology that enables equipment produced for the Space Biology Initiative program to meet specific design and functional requirements in the most efficient and cost effective form consistent with overall mission integration parameters. Each study promulgates rules of thumb, formulas, and matrices that serves as a handbook for the use and guidance of designers and engineers in design, development, and procurement of Space Biology Initiative (SBI) hardware and software.

N93-23080*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 3: HARDWARE MINIATURIZATION VERSUS COST Final Report
L. NEAL JACKSON, JOHN CRENSHAW, SR., WILLIAM L. DAVIDSON (Eagle Engineering, Inc., Houston, TX.), FRANK J. HERBERT (Eagle Engineering, Inc., Houston, TX.), JAMES W. BILODEAU (Eagle Engineering, Inc., Houston, TX.), J. MICHAEL STOVAL (Eagle Engineering, Inc., Houston, TX.), and TERRY SUTTON (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 2 133 p 1 Jun. 1989 Prepared for General Electric Co., Houston, TX
(Contract G966016-J45)
Avail: CASI HC A07/MF A03

The optimum hardware miniaturization level with the lowest cost impact for space biology hardware was determined. Space biology hardware and/or components/subassemblies/assemblies which are the most likely candidates for application of miniaturization are to be defined and relative cost impacts of such miniaturization are to be analyzed. A mathematical or statistical analysis method with the capability to support development of parametric cost analysis impacts for levels of production design miniaturization are provided. Author (revised)

N93-23081*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 6: SPACE STATION FREEDOM/SPACELAB MODULES COMPATIBILITY Final Report
L. NEAL JACKSON, JOHN CRENSHAW, SR., WILLIAM L. DAVIDSON (Eagle Engineering, Inc., Houston, TX.), CAROLYN BLACKNALL (Eagle Engineering, Inc., Houston, TX.), JAMES W. BILODEAU (Eagle Engineering, Inc., Houston, TX.), J. MICHAEL STOVAL (Eagle Engineering, Inc., Houston, TX.), and TERRY SUTTON (Eagle Technical Services, Houston, TX.) *In its* Space Biology Initiative. Trade Studies, Volume 2 122 p 1 Jun. 1989 Prepared in cooperation with General Electric Co., Houston, TX
(Contract G966016-J45; HAG ORDER 966016-J45-EAGLE)
(EEI-89-236) Avail: CASI HC A06/MF A03

The differences in rack requirements for Spacelab, the Shuttle Orbiter, and the United States (U.S.) laboratory module, European Space Agency (ESA) Columbus module, and the Japanese Experiment Module (JEM) of Space Station Freedom are identified. The feasibility of designing standardized mechanical, structural, electrical, data, video, thermal, and fluid interfaces to allow space flight hardware designed for use in the U.S. laboratory module to be used in other locations is assessed. Author (revised)

N93-23082*# Horizon Aerospace, Houston, TX.
SPACE BIOLOGY INITIATIVE PROGRAM DEFINITION REVIEW. TRADE STUDY 2: PROTOTYPE UTILIZATION IN THE DEVELOPMENT OF SPACE BIOLOGY HARDWARE Final Report
L. NEAL JACKSON, JOHN CRENSHAW, SR., ARTHUR E. SCHULZE (Lovelace Scientific Resources, Inc., Albuquerque, NM.), and H. J. WOOD, JR. (Lovelace Scientific Resources, Inc., Albuquerque, NM.) *In its* Space Biology Initiative. Trade Studies, Volume 2 101 p 1 Jun. 1989 Prepared in cooperation with Lovelace Scientific Resources, Inc., Albuquerque, NM
(Contract G966016-J45)
Avail: CASI HC A06/MF A03

The objective was to define the factors which space flight hardware developers and planners should consider when determining: (1) the number of hardware units required to support program; (2) design level of the units; and (3) most efficient means of utilization of the units. The analysis considered technology risk, maintainability, reliability, and safety design requirements for achieving the delivery of highest quality flight hardware. Relative cost impacts of the utilization of prototyping were identified. The development of Space Biology Initiative research hardware will involve intertwined hardware/software activities. Experience has shown that software development can be an expensive portion of a system design program. While software prototyping could imply the development of a significantly different end item, an operational system prototype must be considered to be a combination of software and hardware. Hundreds of factors were identified that could be considered in determining the quantity and types of prototypes that should be constructed. In developing the decision models, these factors were combined and reduced by approximately ten-to-one in order to develop a manageable structure based on the major determining factors. The Baseline SBI hardware list of Appendix D was examined and reviewed in detail; however, from the facts available it was impossible to identify the exact types and quantities of prototypes required for each of these items. Although the factors that must be considered could be enumerated for each of these pieces of equipment, the exact status and state of development of the equipment is variable and uncertain at this time. Derived from text

N93-23169*# Alabama A & M Univ., Normal. Dept. of Plant and Soil Science.
A PROPOSAL TO DEMONSTRATE PRODUCTION OF SALAD CROPS IN THE SPACE STATION MOCKUP FACILITY WITH PARTICULAR ATTENTION TO SPACE, ENERGY, AND LABOR CONSTRAINTS Final Report, 1 Jul. - 31 Dec. 1992
CAROLYN A. BROOKS 31 Dec. 1992 36 p
(Contract NCC2-607)
(NASA-CR-192815; NAS 1.26:192815) Avail: CASI HC A03/MF A01

The Salad Machine Research has continued to be a two path effort with the research at Marshall Space Flight Center (MSFC) focusing on the design, construction, and operation of a semiautomated system (Salad Machine) for the production of salad vegetables within a standard rack. Boeing Corporation in cooperation with NASA MSFC constructed a four drawer Salad Machine which was occasionally placed within the Space Station Freedom Mockup facility for view by selected visitors. Final outfitting of the Salad Machine is awaiting the arrival of parts for the nutrient delivery system. Research at the Alabama A&M facilities focused on compatibility of radish and lettuce plants when grown on the same nutrient solution. Lettuce fresh weight shoot yield was significantly enhanced when lettuce plants were grown on nutrient solution which was shared with radish. Radish tuber production was not significantly affected although there was a trend for radish from shared solutions to be heavier than those grown on separate nutrient solutions. The effect of sharing nutrient solutions on carbohydrate partitioning reflected the effect of sharing solution on fresh weight yield. Lettuce shoot dry weight was significantly greater for plants from shared solutions than from separate. There was no significant effect on sharing nutrient solution on radish tuber dry weight. Partitioning of nitrogen, calcium, magnesium, and potassium was not affected by sharing, there was, however, a disproportionate amount of potassium in the tissues, suggesting luxury consumption of potassium in all plants and tissues. It is concluded that lettuce plants benefit from sharing nutrient solution with radish and that radish is not harmed. Author (revised)

N93-23233*# Eye and Ear Hospital, Pittsburgh, PA.
NEURAL PROCESSING OF GRAVITY INFORMATION Final Technical Report, 1 Nov. 1987 - 30 Jun. 1992
ROBERT H. SCHOR 30 Jun. 1992 3 p
(Contract NCC2-495)
(NASA-CR-192766; NAS 1.26:192766) Avail: CASI HC A01/MF A01

The goal of this project was to use the linear acceleration capabilities of the NASA Vestibular Research Facility (VRF) at Ames Research Center to directly examine encoding of linear accelerations in the vestibular system of the cat. Most previous studies, including my own, have utilized tilt stimuli, which at very low frequencies (e.g., 'static tilt') can be considered a reasonably pure linear acceleration (e.g., 'down'); however, higher frequencies of tilt, necessary for understanding the dynamic processing of linear acceleration information, necessarily involves rotations which can stimulate the semicircular canals. The VRF, particularly the Long Linear Sled, has promise to provide controlled pure linear accelerations at a variety of stimulus frequencies, with no confounding angular motion. Author (revised)

N93-23343# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
BIBLIOGRAPHY OF THE BIOSCIENCES DIVISION: 1986 TO PRESENT
KENNETH N. ACKLES, comp. and ed. Mar. 1992 163 p
(DCIEM-92-20; CTN-93-60696) Avail: CASI HC A08/MF A02

About 330 publications are listed in a bibliography of the work of the Biosciences Division of Canada's Defence and Civil Institute of Environmental Medicine. Papers are arranged by year of publication (1986-1992) and then by author within the following categories: operational medicine, aerospace life sciences, physical performance and thermal stress, impact protection, diving, and robotic technology. An index of authors is included. CISTI

N93-23369# Technical Research Centre of Finland, Espoo. Biotechnical Lab.
BIOTECHNICAL PRODUCTION AND USE OF PYRUVIC ACID WITH SPECIAL REFERENCE TO COENZYME REGENERATION Ph.D. Thesis - Helsinki Univ.
HANNA-LEENA LIVIO Apr. 1991 102 p

(ISSN 0358-5069)
(VTT-PUBS-77; ISBN-951-38-3946-X; ETN-93-93480) Copyright Avail: CASI HC A06/MF A02

The enhancement of pyruvic acid secretion by Candida utilis IFO 0396 was studied with reference to coenzyme regeneration and metabolic modifications. The coenzyme dependent conversion of pyruvate to L-alanine was investigated with immobilized and free enzymes. The aim was to improve pyruvic acid production by Candida utilis by clarifying the metabolic responses to high substrate concentrations and to nitrogen source as well as the role of aeration in the redox balance. Various intracellular modifiers were examined in order to shift the metabolic activity of the yeast towards pyruvic acid overproduction. Pyruvic acid was used for amino acid production with the specific aims of investigating the coupled enzyme system in coenzyme regeneration and comparing the possibilities of different enzyme immobilization methods. ESA

N93-24028# Argonne National Lab., IL.
NONLINEAR OPTICAL PROPERTIES OF PORPHYRIN AND CHLOROPHYLL DIMERS STUDIED BY DEGENERATED FOUR WAVE MIXING
L. X. Q. CHEN 1992 5 p Presented at the International Society for Optical Engineering (SPIE) Conference, Los Angeles, CA, 16-23 Jan. 1993
(Contract W-31-109-ENG-38)
(DE93-006411; ANL/CHM/CP-78537; CONF-930159-3) Avail: CASI HC A01/MF A01

As one of the important elements in natural and artificial electron transfer and energy transfer processes, porphyrin and its derivatives have received much attention in photoelectronics and photoelectronic materials. As our first attempt to relate the pi-pi electronic couplings between porphyrin macrocycles to apparent third order nonlinear susceptibilities, we measured chi(sup 3) for several porphyrin and chlorophyll a derivatives, including dimers with different configurations. Our preliminary results show that the dimers have enhanced chi(sup 3) compared to those of the monomer. This enhancement is related to the relative orientations between the two macrocycles in the dimers. The parallel dimers with close face-to-face distances seem to have the highest enhancement in chi(sup 3). Thus, we believe that chi(sup 3) is strongly related to the pi-pi electronic coupling between the two conjugated ring systems. DOE

N93-24379# Trondheim Univ. (Norway).
THE USO-CONCEPT APPLIED TO A BIOLOGICAL MODEL EXPERIMENT
T.-H. IVERSEN, E. B. SKAGEN, C. BAGGERUD, T. BEISVAAG, O. S. RASMUSSEN (Aarhus Univ., Denmark.), T. A. E. ANDERSEN (Danish Aerospace Medical Center of Research, Copenhagen.), H. T. BLUME (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. BROUWER (National Aerospace Lab., Emmeloord, Netherlands.), L. DANGELO (Microgravity Advanced Research and Support Center, Naples, Italy.), H. DUWE (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) et al. *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 241-244 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

For the European User Support Organisation (USO) definition study, the payload flow of a plant bology model experiment planned for the Columbus Attached Laboratory (CAL), is described. The implementation of the user support functions from the initial scientific idea, through the operation in space, to the completion of the experiment on the ground and publication of the results, is described. The plant material consists of cell wall free plant cells (protoplasts) and their regeneration processes via cell cultures to new plants. Results obtained from preliminary work using clinostats on ground and under microgravity conditions onboard Biokosmos 9 and IML 1 on the Space Shuttle are included. Interpretation problems arising as a result of the hardware used and technical constraints are discussed within the USO concept. ESA

N93-24401# Ruhr Univ., Bochum (Germany). Comparative Endocrinology Research Section.
CEBAS-AQUARACK: AN ARTIFICIAL AQUATIC ANIMAL PLANT ECOSYSTEM AS A TOOL FOR BASIC RESEARCH IN THE COLUMBUS SPACE STATION
V. BLUEM, K. KREUZBERG (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), and E. STRETZKE *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 359-364 Jul. 1992 Sponsored by Ministry of Science and Research
(Contract BMFT-50-QV-8846)
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The CEBAS (Closed Equilibrated Biological Aquatic System) Aquarack project, including its scientific frame program is primarily dedicated to basic research to study the influence of space conditions on aquatic animals and plants in long term multigeneration experiments. It also represents an extensively self maintaining closed artificial aquatic ecosystem for fish and higher water plants or microalgae and may have potential application for producing food in space. CEBAS is already operative in two versions of laboratory models in the frame of an international basic research program. It is a German option for the Columbus space station. CEBAS consists of a zoological component (animal tank including water recycling system), a botanical component (higher water plant compartment of microalgal bioreactor) and an electronical component (process control system). The basic concept and the organization of the scientific frame program are explained and latest examples of results of the current zoological research with special respect to reproductive biology are presented. The problems of intensive aquaculture systems, especially combined ones, disposed for the utilization in lunar or planetary bases are discussed. ESA

N93-24402# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
JAPANESE TREEFROG EXPERIMENT ONBOARD THE SPACE STATION MIR
MASAMICHI YAMASHITA and AKEMI IZUMI-KUROTANI *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 365-369 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

An experiment investigating the postures and behavior of Japanese treefrogs Hyala japonica during 8 days on the Mir Space Station is presented. The frogs floated in a free volume with four legs stretched and body bent backward. Some of behaviors shown by the frogs are never or rarely observed on ground. Many of the frogs bent their neck severely backward when they perched in a surface, and walked backward some time. Degree of adaptation to space environment, in terms of behaviors, was evaluated by repeating the experiment on a different day. Number of failure at landing on a surface from free floating in a space was found to decrease at the later day in orbit. Readaptation process were analyzed at their recovery to ground. Changes of bone, muscle, inner ear, and hormones were investigated in the recovered frogs. ESA

N93-24403# Paris VI Univ. (France).
GRAVITY AND ROOT MORPHOGENESIS
G. PERBAL and D. DRISS-ECOLE *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 371-377 Jul. 1992 Sponsored by CNES
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Results of experiments to investigate the effects of gravity on root morphogenesis are presented and discussed. When a seedling

root is placed in the horizontal position its extremity bends in order to recover its initial orientation with respect to gravity. The curvature is due to a differential growth in the lower and upper sides of this organ. In microgravity, cell elongation occurred closer to the root meristem than in the 1 G centrifuge and the mitotic index was greater. In microgravity, a relaxation of the cytoskeleton of statocytes was also observed. It is proposed that on the ground minuscule forces are exerted by the statoliths on the periphery of the statocytes and that these forces lead to a symmetrical signal responsible for straight growth. When the root is placed in the horizontal position, on the contrary, the pressure of the statoliths creates an asymmetrical message which provokes the gravitropic curvature. ESA

N93-24404# Nottingham Univ. (England). Dept. of Life Science.
DEVELOPMENT OF ARABIDOPSIS THALIANA GROWN UNDER MICROGRAVITY CONDITIONS
L. G. BRIARTY and E. P. MAHER (Open Univ., Scotland.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 379-384 Jul. 1992 Sponsored by United Kingdom Science and Engineering Research Council and Nottingham Univ. National Westminster Bank Research Fund
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

An experiment to determine the effects of microgravity conditions on the early growth of Ariabidopsis thaliana wild-type and aux-1 mutant seedlings was developed and flown in the biorack on the IML-1 mission of Spacelab in January 1992. The experiment was carried out successfully and seedlings fixed at four stages of germination were returned to Earth; early analysis shows little difference in growth rates in microgravity and 1 G of the roots and hypocotyls of the plants, though hypocotyl hook formation appears altered in microgravity. Further studies of cell and tissue structure in the various plant organs are under way. ESA

N93-24455# Southwest Research Inst., San Antonio, TX. Dept. of Biosciences and Bioengineering.
INVESTIGATION OF EFFECTS OF 60-HZ ELECTRIC AND MAGNETIC FIELDS ON OPERANT AND SOCIAL BEHAVIOR AND ON THE NEUROENDOCRINE SYSTEM OF NONHUMAN PRIMATES
H. SMITH 22 Jan. 1993 288 p
(Contract DE-AC02-80RA-50219)
(DE93-007678; DOE/RA-50219/T28) Avail: CASI HC A13/MF A03

The objective of this program is to investigate behavioral and neuroendocrine effects associated with exposure to 60-Hz electric and magnetic fields (E/MF), using the baboon (Papio cynocephalus) as a nonhuman primate surrogate for the human. Results from this program, along with information from experiments conducted elsewhere, could be used to estimate and evaluate the likelihood of deleterious consequences of human exposure to the electric and magnetic fields associated with electric power transmission. DOE

N93-25104# Oak Ridge National Lab., TN.
KINETIC STUDIES OF INTERFACIAL PHOTOCURRENTS IN PLATINIZED CHLOROPLASTS
E. GREENBAUM 1992 2 p Presented at the 183rd Electrochemical Society Meeting, Honolulu, HI, 16-21 May 1993
(Contract DE-AC05-84OR-21400)
(DE93-002344; CONF-930571-1) Avail: CASI HC A01/MF A01

The present experiments focus on kinetic studies of photocurrents generated in a photobioelectrochemical cell constructed from platinized chloroplast membranes. These chloroplast membranes although separated from the CO2-reducing enzymes of the Calvin-Benson cycle, contain the full complement of photosystem 1 and 2 reaction centers along with the electron transport chain linking these two centers. The vectorial model of photosynthesis indicates that the orientation of the reaction centers in the photosynthetic membranes is such that electrons emerge from the membranes into the stroma region of the chloroplasts. Since the flattened saclike vesicles of the thylakoid membranes are topologically equivalent to spheres, it follows that, irrespective of the rotational orientation of the membranes, the photogenerated electrons emerge from the reaction centers in a radial direction away from the intra-thylakoid region. DOE

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A93-30276* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AGE, CIRCADIAN RHYTHMS, AND SLEEP LOSS IN FLIGHT CREWS
PHILIPPA H. GANDER, DE NGUYEN (San Jose State Univ. Foundation; NASA, Ames Research Center, Moffett Field, CA), MARK R. ROSEKIND, and LINDA J. CONNELL (NASA, Ames Research Center, Moffett Field, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 189-195. refs
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Age-related changes in trip-induced sleep loss, personality, and the preduty temperature rhythm were analyzed in crews from various flight operations. Eveningness decreased with age. The minimum of the baseline temperature rhythm occurred earlier with age. The amplitude of the baseline temperature rhythm declined with age. Average daily percentage sleep loss during trips increased with age. Among crewmembers flying longhaul flight operations, subjects aged 50-60 averaged 3.5 times more sleep loss per day than subjects aged 20-30. These studies support previous findings that evening types and subjects with later peaking temperature rhythms adapt better to shift work and time zone changes. Age and circadian type may be important considerations for duty schedules and fatigue countermeasures. Author

A93-30278
COMPUTERIZED TASK BATTERY ASSESSMENT OF COGNITIVE AND PERFORMANCE EFFECTS OF ACUTE PHENYTOIN MOTION SICKNESS THERAPY
WILLIAM CHELEN (USAF, Inst. of Technology and Aerospace Medical Research Lab., Wright-Patterson AFB; Wright State Univ., Dayton, OH), NAGIN AHMED, MATTHEW KABRISKY, and STEVEN ROGERS (USAF, Inst. of Technology and Aerospace Medical Research Lab., Wright-Patterson AFB, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 201-205. refs
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Phenytoin was previously evaluated as an efficacious anti-motion sickness therapy in more than 24 individuals. To be effective, this short-term, novel therapy requires serum levels in the anticonvulsant range; therefore, it became imperative that the effects of phenytoin upon cognition and performance be quantified. Each subject was tested on a performance battery (Criterion Task Set) on two occasions while on either phenytoin treatment or placebo for subsequent statistical comparison. We evaluated 23 subjects with phenytoin serum levels ranging from 8.9 to 23.9 micro-g/L. While subjects with the higher serum levels consistently reported subjective side effects, there was no statistically significant degradation of sensory, cognitive, or performance capabilities compared to placebo. Author

A93-30279
EFFECT OF TASK COMPLEXITY ON MENTAL PERFORMANCE DURING IMMERSION HYPOTHERMIA
GORDON G. GIESBRECHT, J. L. ARNETT, E. VELA, and G. K. BRISTOW (Manitoba Univ., Winnipeg, Canada) Aviation, Space,

and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 206-211. Research supported by Randy Chipperfield Hypothermia Research Fund and Manitoba Health Research Council refs
Copyright

The effect of task complexity on the decrement in mental performance during immersion hypothermia was studied. Results indicated that tests placing relatively minimal cognitive demands on individuals, such as auditory attention, the Benton visual recognition test and forward digit span, were unaffected by either initial cold water immersion or central cooling. On the other hand, tests requiring relatively greater mental manipulation and short term memory or processing and analysis showed a slight improvement upon cold water immersion but a significant decrement following central cooling of 2-4 C. Thus, relatively simple tasks were unaffected by central cooling, where more complex tasks were adversely affected. Cold water immersion itself did not interfere with performance of any tasks. Author

A93-30280
MAGNETIC RESONANCE IMAGING EVALUATION OF LOWER LIMB MUSCLES DURING BED REST - A MICROGRAVITY SIMULATION MODEL

P. BERRY, I. BERRY, and C. MANELFE (Hopital Purpan, Toulouse, France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 212-218. Research supported by CNES, Centre Hospitalier Regional de Toulouse, and Fondation pour la Recherche Medicale refs
(Contract DRET-89-237)
Copyright

Head-down bed rest, a microgravity simulation model in humans, leads to muscular atrophy of the lower limbs. Magnetic Resonance Imaging (MRI) at 0.5 tesla was performed at 1 year intervals on the same six volunteers (except one) before and after 1 month bed rest. Three of the six subjects were daily exposed in a lying position to LBNP (lower body negative pressure), a countermeasure to cardiovascular deconditioning (LBNP group). The groups were exchanged the second year. After bed rest, the quadriceps of the thigh lost uniformly 11 percent of its cross section area (CSA) and the triceps of the leg 10.5 percent, with 12.8 percent lost from the deeper soleus versus 8.5 percent from the gastrocnemius. LBNP produced no effect on these changes. The MRI signal intensity of muscles exhibited a trend toward higher values after bed rest although without statistical significance. Author

A93-30281
CARDIOVASCULAR RESPONSES TO UPRIGHT TILT AT A SIMULATED ALTITUDE OF 3,700 M IN MEN

S. SAGAWA, K. SHIRAKI, K. MIKI, and F. TAJIMA (Univ. of Occupational and Environmental Health, Kitakyushu, Japan) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 219-223. Research supported by Univ. of Occupational and Environmental Health refs
Copyright

To examine the effects of high altitude on cardiovascular responses to orthostasis, 11 healthy males were tested at a 10-min passive 70 deg head-up tilt at sea level and at a simulated high altitude of 3700 m. During the control period in the supine position, heart rate and forearm blood flow were higher at high altitude. Mean arterial pressure remained unchanged during head-up tilt at sea level, but it reduced from 82 mm Hg to 72 mm Hg during head-up tilt at high altitude. There were no altitude-related changes in the magnitude of the increase in forearm vascular resistance and the reduction in cardiac output and laser-Doppler skin blood flow in response to head-up tilt. The total peripheral resistance increased from 14.4 to 20.5 mm Hg/L/min during head-up tilt at sea level, but the change was not significant at high altitude. Author

A93-30282
CARDIOVASCULAR RESPONSES DURING RECOVERY FROM EXERCISE AND THERMAL STRESS

ROBERT D. KILGOUR, PHILIPPE GARIEPY, and RON REHEL (Concordia Univ., Montreal, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 224-229. Research supported by Concordia Univ refs
Copyright

This study examined heart rate (HR), stroke index (SI), cardiac index (CI), systemic vascular resistance (SVR), systolic (SBP) and diastolic (DBP) blood pressure in 8 males during 15 min of passive seated recovery preceded by 30 min of cycle ergometry on two separate occasions: under control (C) and heat stress (HS) conditions. During both recovery conditions, SI significantly declined to below preexercise values. No differences were observed between groups with respect to SI. The decrease in recovery HR was slower in HS than C. The greater elevation in HR during HS accounted for the relative increase in CI above that observed prior to exercise. The estimated SVR measured immediately following exercise in both groups was lower than preexercise values. By 5 min of C recovery, SVR returned to baseline values but remained significantly depressed for the entire HS condition. Author

A93-30283* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TREATMENT EFFICACY OF INTRAMUSCULAR PROMETHAZINE FOR SPACE MOTION SICKNESS

JEFFREY R. DAVIS (NASA, Johnson Space Center, Houston; American Airlines, Inc., Medical Dept., Fort Worth, TX), RICHARD T. JENNINGS, BRADLEY G. BECK, and JAMES P. BAGIAN (NASA, Johnson Space Center, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 230-233. refs
Copyright

Intramuscular promethazine and its efficacy in the treatment of Space Motion Sickness (SMS) were evaluated using standardized questions administered during postflight debriefings to crewmembers immediately after their first Shuttle flight. The comparison showed that 25 percent of crewmembers treated with IM promethazine were 'sick' on flight day 2, compared to 50 percent of crewmembers who did not receive promethazine, 90 percent reported immediate symptom relief as well. Untreated crewmembers typically have slow symptom resolution over 72-96 h, and those treated with oral scopolamine/dextroamphetamine show delayed symptom development. This study suggests that intramuscular promethazine is an effective treatment for SMS and merits continued use and further controlled investigations. Author

A93-30284
RETROPERITONEAL FIBROSIS AS A CAUSE OF HYPERTENSION IN AN AVIATOR - A CASE REPORT

LOUIS H. SMITH, III (U.S. Army, 5th Special Forces Group /Airborne/, Fort Campbell, KY) and RICHARD S. BROADHURST (U.S. Army, 10th Special Forces Group /Airborne/, Bad Toelz, Germany) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 234, 235. refs
Copyright

The authors describe a case report of a previously healthy rotary-wing aviator who developed hypertension of unknown etiology. His 30 pack/year smoking history and hypercholesterolemia were significant. The initial evaluation revealed an elevated creatinine of 1.7. Right-sided hydronephrosis was noted on ultrasound and the right kidney was poorly visualized on IVP. A subsequent retrograde cystoureterogram confirmed the hydronephrosis and demonstrated a distal calculus and stenosis, findings which were compatible with retroperitoneal fibrosis. This diagnosis was confirmed at surgery and the patient's ureters were freed. Following surgery, return of normal kidney function and satisfactory recovery, this aviator returned to full flying duty. Author

A93-30285* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LIMITATIONS TO THE STUDY OF MAN IN SPACE IN THE U.S. SPACE PROGRAM
PHILLIP A. BISHOP (Alabama Univ., Tuscaloosa; NASA, Johnson Space Center, Houston, TX) and MIKE GREENISEN (NASA, Johnson Space Center, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 238-242. refs
(Contract NAS9-18440)
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Research on humans conducted during spaceflight is fraught both with great opportunities and great obstacles. The purpose of this paper is to review some of the limitations to research in space in the United States with hope that an informed scientific community may lead to more rapid and efficient solution of these problems. Limitations arise because opportunities to study the same astronauts in well-controlled situations on repeated spaceflights are practically non-existent. Human research opportunities are further limited by the necessity of avoiding simultaneous mutually-interfering experiments. Environmental factors, including diet and other physiological perturbations concomitant with spaceflight, also complicate research design and interpretation. Technical limitations to research methods and opportunities further restrict the development of the knowledge base. Finally, Earth analogues of space travel all suffer from inadequacies. Though all of these obstacles will eventually be overcome, creativity, diligence, and persistence are required to further our knowledge of humans in space. Author

A93-30286
RATIONALE FOR A HYPERBARIC TREATMENT CAPABILITY AT A LUNAR STATION
GENE L. DOWELL (U.S. Navy, Naval Aerospace Medical Inst., Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 243-246. refs
Copyright

Missions to establish a permanent presence on the Moon will include a significant amount of extravehicular activity (EVA), which carries the risk of decompression sickness (DCS). Factors which will influence that risk include: cabin and space suit pressure environments, frequency of and activity level during EVA, and the possibility of a loss-of-pressure mishap. These factors were considered for Space Station Freedom (SSF), resulting in the decision to include a hyperbaric airlock capable of treating DCS. Using concepts from operational medicine, the need for such a capability is determined by its influence on mission risk. In comparison to SSF, a Lunar Station will have gravity, a higher EVA rate, physically more DCS provocative EVA, and little, if any, capacity for medical evacuation. Therefore, unless Lunar mission planners can provide pressure environments that offer near zero risk of DCS for nominal operations, a hyperbaric treatment capability should be included. Author

A93-30435
CHANGES OF CAMP AND CGMP CONTENT IN PLASMA AND URINE BEFORE AND AFTER PARALLEL SWING STIMULATION
DI-MING CHEN, XIU-WEN LI, SHU-CHUN LI, and BO-LUN TONG (Inst. of Space Medico-Engineering, Beijing, China) Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 235-244. refs

Changes of cAMP and cGMP in plasma and urine after parallel swing stimulation in dogs and human subjects were studied. In dogs, plasma cAMP concentration and cAMP/cGMP ratio increased significantly half an hour after stimulation. In men, along with the decrease of urine volume urine cAMP concentration and cAMP/cGMP ratio also increased significantly. The results indicated that urine cAMP concentration and cAMP/cGMP ratio might be objective indicators for motion sickness diagnosis and susceptibility classification. Author

A93-30436
SELF-ORGANIZING CHARACTER OF ALPHA WAVE IN EEG DUE TO ACUTE HYPOXIC HYPOXIA IN NORMAL SUBJECTS
CHUAN-DAI ZHOU (Inst. of Space Medico-Engineering, Beijing, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 245-249. In Chinese. refs

The synergetic structure of alpha frequency components in EEG was studied in 15 normal healthy volunteers aged 18-22 years under normobaric hypoxic condition induced by inhalation of a hypoxic gas mixture for 30 min. The results showed that the synergetic structure of alpha frequency components in EEG under hypoxia could be identified for two stages: (1) Fluctuation of energy of alpha converged on the main frequency component and the brain was self-organized in a new situation in order to adapt itself to hypoxia. (2) The main frequency component shifted to lower frequency and the energy fluctuation of alpha was almost equally distributed among principal components of alpha, which reflected that human tolerance to hypoxia declined. Author

A93-30445
CARDIOVASCULAR PROBLEMS DURING SPACE FLIGHT
XIAN-YUN SHEN (Inst. of Space Medico-Engineering, Beijing, China) Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 295-301. In Chinese. refs

Cardiovascular function is one of the main functions disturbed by microgravity. The following cardiovascular changes were observed during actual or simulated microgravity: increase of regular and central venous pressure, decrease of venous pressure in the legs, increase of intracranial pressure and blood volume, disorder in microcirculation and blood rheology, orthostatic intolerance, and impaired exercise capacity. The exact biologic mechanisms of the cardiovascular deconditioning responses have been established; the author suggests the following five factors as the main causes: reduction in plasma volume, changes in baroreactor reflex function, disorder in microcirculation and blood rheology, alterations in vessel compliance and capacity, and muscle atrophy with decrease in pumping function. Countermeasures used in space flight were reviewed. Author

A93-30771
A REVIEW OF MUSCLE ATROPHY IN MICROGRAVITY AND DURING PROLONGED BED REST
PIETER M. DROPPERT (Manchester, Victoria Univ.; Withington Hospital, United Kingdom) British Interplanetary Society, Journal (ISSN 0007-094X) vol. 46, no. 3 March 1993 p. 83-86. refs
Copyright

With the prospect of long duration space missions in earth orbit or to Mars, there is a need for adequate information on the physiological adaptations that will occur. One consequence of prolonged exposure to microgravity is muscle atrophy (loss of muscle mass). After a long duration space flight, muscle atrophy along with skeletal calcium loss would affect the capacity of astronauts to readapt to gravity on return to earth. Of importance are any countermeasures which can attenuate the adaptive responses to microgravity. Experimentation is difficult in space with small subject numbers and mission constraints. Prolonged bed rest using healthy volunteers is used as an earth-based model to simulate the muscle atrophy which occurs in the microgravity environment. Author

A93-30772
PREDICTING SKELETAL ADAPTATION IN ALTERED GRAVITY ENVIRONMENTS
TONY S. KELLER (Vermont Univ., Burlington) and ALVIN M. STRAUSS (Vanderbilt Univ., Nashville, TN) British Interplanetary Society, Journal (ISSN 0007-094X) vol. 46, no. 3 March 1993 p. 87-96. Research supported by USVA refs
Copyright

It is generally agreed that the single factor that most limits human survivability in non-Earth environments is the phenomenon of bone demineralization and the medical problems induced by

the subsequent imbalance in the calcium metabolism. Alterations of skeletal properties occur as a result of disturbances in the normal mechanical loading environment of bone. These alterations or 'adaptations' obey physical laws, but the precise mathematical relationships remain to be determined. Principles governing unloading and overloading of bone are gaining more attention as a consequence of the planning of manned space stations, moon and Mars bases and spaceflights of long duration. This paper reviews the subject of bone remodeling and presents a mathematical framework which allows for the prediction of skeletal adaptation on Earth and in non-Earth gravity environments by power law relationships. Author

A93-30773
THE EFFECTS OF PROLONGED WEIGHTLESSNESS AND REDUCED GRAVITY ENVIRONMENTS ON HUMAN SURVIVAL
RICHARD L. S. TAYLOR (Birkbeck College, London, United Kingdom) British Interplanetary Society, Journal (ISSN 0007-094X) vol. 46, no. 3 March 1993 p. 97-106. refs
Copyright

An examination is conducted of the physiological changes associated with microgravity conditions, giving attention to bone demineralization. Many of these changes are due to physical/mechanical processes that are not primarily medical, suggesting two feasible, if costly, solutions to the problem of prolonged weightlessness: (1) provision of a near-1G field during space travel, and/or (2) the development of a rapid-transit spacecraft with short mission flight times. It is not yet known whether there is a G-value below which human physiological function cannot be sustained. O.C.

A93-31267* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
A COMPARISON OF NEURAL NETWORK AND FUZZY CLUSTERING TECHNIQUES IN SEGMENTING MAGNETIC RESONANCE IMAGES OF THE BRAIN
LAWRENCE O. HALL, AMINE M. BENSAID, LAURENCE P. CLARKE, ROBERT P. VELTHUIZEN, MARTIN S. SILBIGER (South Florida Univ., Tampa, FL), and JAMES C. BEZDEK (West Florida Univ., Pensacola, FL) IEEE Transactions on Neural Networks (ISSN 1045-9227) vol. 3, no. 5 Sept. 1992 p. 672-682. Research supported by NASA, Siemens Medical Systems, Sun Microsystems, Inc., et al. refs
(Contract NSF IRI-90-03252)
Copyright

Magnetic resonance (MR) brain section images are segmented and then synthetically colored to give visual representations of the original data with three approaches: the literal and approximate fuzzy c-means unsupervised clustering algorithms and a supervised computational neural network, a dynamic multilayered perception trained with the cascade correlation learning algorithm. Initial clinical results are presented on both normal volunteers and selected patients with brain tumors surrounded by edema. Supervised and unsupervised segmentation techniques provide broadly similar results. Unsupervised fuzzy algorithms were visually observed to show better segmentation when compared with raw image data for volunteer studies. However, for a more complex segmentation problem with tumor/edema or cerebrospinal fluid boundary, where the tissues have similar MR relaxation behavior, inconsistency in rating among experts was observed. Author

A93-31531
EFFECTS OF VISUALLY INDUCED SELF-MOTION PERCEPTION (VECTION) ON UPRIGHT STANDING POSTURE
MASUMI ICHIKAWA (Toyota College of Technology, Japan) and SATORU WATANABE (Nagoya Univ., Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723) vol. 29, no. 4 Dec. 1992 p. 107-116. Research supported by Special Coordination Fund for Science and Technology of Japan refs
Copyright

The relationship between the magnitude of visually induced perception of self-motion (vection) and the forward body tilt induced by optokinetic stimulation (OKS) was investigated in 12 healthy human subjects who were presented with a large hemispherical dome screen which had a pattern on it which was moved downward. Each subject stood on a force-measuring platform in Romberg's position and gazed at a red fixation point in the center of the screen. The analysis of data indicated that there was a close relationship between the magnitude of vection and the forward displacement of the center of gravity caused by OKS. I.S.

A93-31545* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PREVENTION OF SPACE FLIGHT INDUCED SOFT TISSUE CALCIFICATION AND DISUSE OSTEOPOROSIS
VICTOR S. SCHNEIDER (NASA, Johnson Space Center, Houston, TX), ADRIAN LEBLANC (Baylor College of Medicine, Houston, TX), and CAROLYN L. HUNTOON (NASA, Johnson Space Center, Houston, TX) Acta Astronautica (ISSN 0094-5765) vol. 29, no. 2 Feb. 1993 p. 139, 140. Previously cited in issue 03, p. 400, Accession no. A91-14163 refs
Copyright

A93-32120* National Aeronautics and Space Administration, Washington, DC.
MELATONIN AND ITS PRECURSORS IN Y79 HUMAN RETINOBLASTOMA CELLS - EFFECT OF SODIUM BUTYRATE
MEI H. DENG, IGNACIO LOPEZ G.-COVIELLA, HARRY J. LYNCH, and RICHARD J. WURTMAN (MIT, Cambridge, MA) Brain Research (ISSN 0006-8993) vol. 561 1991 p. 274-278. Research supported by USAF and NASA refs
Copyright

We studied the release of melatonin and the production of its precursors, 5-hydroxytryptophan and serotonin, in cultured Y79 human retinoblastoma cells. This biosynthetic capability was found to be dependent on cell differentiation, which was initiated by culturing Y79 cells for 7 days in dishes coated with poly-D-lysine to promote cell adhesion to the surface of the culture dishes. Differentiation was further induced by exposing the cell monolayer to sodium butyrate (3 mM) for three days. This protocol dramatically increased the release of melatonin, and the syntheses of 5-hydroxytryptophan and serotonin in response to forskolin stimulation. Exposure to dopamine or L-DOPA markedly diminished the forskolin-stimulated release of melatonin, as well as the production of 5-hydroxytryptophan and serotonin. These observations indicate that Y79 cells represent a primitive cell line which, following appropriate differentiation can display biochemical characteristics similar to those of the human retina. Moreover, serotonin synthesis and melatonin release appear to be coupled in Y79 ceils. Author

A93-32176* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RELATION BETWEEN PERCEPTION OF VERTICAL AXIS ROTATION AND VESTIBULO-OCULAR REFLEX SYMMETRY
ROBERT J. PETERKA and MARTHA S. BENOLKEN (Good Samaritan Hospital and Medical Center, Portland, OR) Journal of Vestibular Research (ISSN 0957-4271) vol. 2 1992 p. 59-69. Previously announced in STAR as N91-19710 refs
(Contract NAG9-117)
Copyright

Subjects seated in a vertical axis rotation chair controlled their rotational velocity by adjusting a potentiometer. Their goal was to null out pseudorandom rotational perturbations in order to remain perceptually stationary. Most subjects showed a slow linear drift of velocity (a constant acceleration) to one side when they were deprived of an earth-fixed visual reference. The amplitude and direction of this drift can be considered a measure of a static bias in the subject's perception of rotation. The presence of a perceptual bias is consistent with a small, constant imbalance of vestibular function which could be of either central or peripheral origin. Deviations from perfect vestibulo-ocular reflex (VOR) symmetry are also assumed to be related to imbalances in either peripheral or central vestibular function. Researchers looked for correlations between perceptual bias and various measures of

vestibular reflex symmetry that might suggest a common source for both reflective and perceptual imbalances. No correlations were found. Measurement errors could not account for these results since repeated tests on the same subjects of both perceptual bias and VOR symmetry were well correlated. Author

A93-32474* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MELATONIN IN HUMAN PREOVULATORY FOLLICULAR FLUID
AMNON BRZEZINSKI, MACHELLE M. SEIBEL, HARRY J. LYNCH, MEI-HUA DENG, and RICHARD J. WURTMAN (MIT, Cambridge; Beth-Israel Hospital, Boston, MA) Journal of Clinical Endocrinology and Metabolism (ISSN 0021-972X) vol. 64, no. 4 1987 p. 865-867. refs
(Contract NAG2-210)
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Melatonin, the major hormone of the pineal gland, has antigonadotrophic activity in many mammals and may also be involved in human reproduction. Melatonin suppresses steroidogenesis by ovarian granulosa and luteal cells in vitro. To determine if melatonin is present in the human ovary, preovulatory follicular fluids (n = 32) from 15 women were assayed for melatonin by RIA after solvent extraction. The fluids were obtained by laparoscopy or sonographically controlled follicular puncture from infertile women undergoing in vitro fertilization and embryo transfer. All patients had received clomiphene citrate, human menopausal gonadotropin, and hCG to stimulate follicle formation. Blood samples were obtained by venipuncture 30 rain or less after follicular aspiration. All of the follicular fluids contained melatonim, in concentrations substantially higher than those in the corresponding serum. A positive correlation was found between follicular fluid and serum melatonin levels in each woman; these observations indicate that preovulatory follicles contain substantial amounts of melatonin that may affect ovarian steroidogenesis.
Author

A93-32774* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RESPONSE CHARACTERISTICS OF THE HUMAN TORSIONAL VESTIBULOOCULAR REFLEX
ROBERT J. PETERKA (Good Samaritan Hospital & Medical Center, Portland, OR) New York Academy of Sciences, Annals (ISSN 0077-8923) vol. 656 May 22, 1992 p. 877-879. refs
(Contract NAG9-117)
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The characteristics of the response dynamics of the human torsional vestibuloocular reflex were studied during controlled rotations about an earth-horizontal axis. The results extended the frequency range to 2 Hz and identified the nonlinearity of the amplitude response. AIAA

A93-32775
PERIPHERAL ARTERIAL THROMBOSIS RELATED TO COMMERCIAL AIRLINE FLIGHTS - ANOTHER MANIFESTATION OF THE ECONOMY CLASS SYNDROME
R. P. TEENAN and A. J. MCKAY (Gartnavel General Hospital, Glasgow, United Kingdom) British Journal of Clinical Practice (ISSN 0007-0947) vol. 46, no. 3 Fall 1992 p. 165, 166.
Copyright

Venous thromboembolism is a well recognized complication of air travel, particularly on long haul flights. This has been attributed to relative immobility in cramped surroundings and to dehydration secondary to alcohol consumption and low cabin humidity. Under these conditions thrombosis at other sites would be expected, and indeed myocardial ischaemia is the commonest emergency in commercial flights. Peripheral arterial thrombosis, however, is not reported, even in comprehensive reviews of flying related medical emergencies. We report on three patients who developed acute lower limb ischaemia following long haul air flights. Author

A93-32776
OCCUPATIONAL DERMATITIS IN THE AIRCRAFT INDUSTRY - 35 YEARS OF PROGRESS
P. Y. CASTELAIN, J. COM, and M. CASTELAIN (Hopital Sainte Marguerite, Marseille, France) Contact Dermatitis (ISSN 0105-1873) vol. 27, no. 5 Nov. 1992 p. 311-316.
Copyright

A comparison of the occupational dermatitis occurring in the same aircraft factory during 2 separate decades, 1955-1965 and 1981-1990, is presented. Subungual pulpitis is highly specific to this industry, because of the handling of resins and sealing agents. The number of cases dropped from 122 to 40, in accordance with progress in preventive medicine and technological changes in the factory. Irritant contact dermatitis nevertheless remained appreciable, while allergic contact dermatitis greatly decreased.
Author

A93-32777
HYPERTENSION AND THE PROBABILITY OF AN INCAPACITATING EVENT OVER A DEFINED PERIOD - IMPACT OF TREATMENT
N. POULTER and M. G. MARMOT (Univ. College; Middlesex School of Medicine, London, United Kingdom) European Heart Journal (ISSN 0195-668X) vol. 13, Supplement H Dec. 1992 p. 39-44.
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The risks of coronary heart disease, cerebrovascular disease and all-cause mortality associated with increasing levels of pressure are graded and continuous from the lowest to the highest levels. Data from several large prospective studies allow evaluation of individual risk based on blood pressure level but may require modification in the context of aircrew. Because cardiovascular risk factors appear to interact and 'cluster' in hypertensives, a broadened approach to the evaluation of risk for the individual and the management of hypertension is necessary and appropriate. Anti-hypertensive treatment has been shown in trials to reduce the incidence of stroke but appears much less effective at reducing coronary events. It may be that a management policy which involves an assessment of and intervention on all risk factors together, incorporating the use of anti-hypertensive drugs which do not have adverse metabolic effects will be more effective in this context. Evaluation of such a policy in a long-term morbidity and mortality trial is however urgently required. Author (revised)

A93-32778
CARDIAC PACING AND AVIATION
W. D. TOFF, O. K. EDHAG, and A. J. CAMM (Royal Free Hospital, London, United Kingdom) European Heart Journal (ISSN 0195-668X) vol. 13, Supplement H Dec. 1992 p. 162-175.
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Certain applicants with stable disturbances of rhythm or conduction requiring cardiac pacing, in whom no other disqualifying condition is present, may be considered fit for medical certification restricted to multi-crew operations. The reliability of modern pacing systems appears adequate to permit restricted certification even in pacemaker dependent subjects except for certain models of pacemakers and leads known to be at increased risk of failure. These are to be avoided. There is little evidence to suggest that newer devices are any more reliable than their predecessors. Single and dual chamber systems appear to have similar reliability up to 4 years, after which time significant attrition of dual chamber devices occurs, principally due to battery depletion. All devices require increased scrutiny as they approach their end of life as predicted from longevity data and pacing characteristics. The impracticality of restricted certification in helicopters will, in any event, preclude certification. Such devices would best be avoided in hovercraft (air cushioned vehicle) pilots. Only minor rate rises are likely in fixed-wing aircraft which are unlikely to be of significance. Anti-tachycardia devices and implanted defibrillators are inconsistent with any form of certification to fly. Author (revised)

A93-32781* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
ENHANCED CAROTID-CARDIAC BAROREFLEX RESPONSE AND ELIMINATION OF ORTHOSTATIC HYPOTENSION 24 HOURS AFTER ACUTE EXERCISE IN PARAPLEGICS
K. A. ENGELKE, J. D. SHEA, D. F. DOERR, and V. A. CONVERTINO (NASA, Kennedy Space Center, Cocoa Beach, FL) Paraplegia (ISSN 0031-1758) vol. 30, no. 12 Dec. 1992 p. 872-879.
Copyright

To test the hypothesis that an acute bout of maximal exercise can ameliorate orthostatic hypotension consequent to prolonged wheelchair confinement, we evaluated heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure responses during 15 minutes of 70 degrees head-up tilt (HUT) in 10 paraplegic subjects 24 hours after arm crank exercise designed to elicit maximal effort, and during a control (no exercise) conditions. Additionally, the carotid baroreceptor stimulus-cardiac response relationship was determined by measurement of R-R interval during external application of graded pressures to the carotid sinuses. One week separated the treatment conditions. The maximum slope of the carotid-cardiac baroreflex response was increased ($p = 0.049$) by exercise (6.2 +/- 1.7 msec/mmHg) compared to control (3.3 +/- 0.6). During control HUT, HR increased from 61 +/- 1 to 90 +/- 7 bpm ($p = 0.001$) while SBP decreased from 118 +/- 5 to 106 +/- 9 mmHg ($p = 0.025$). During HUT 24 hours after exercise, HR increased from 60 +/- 2 to 90 +/- 4 bpm ($p = 0.001$), but the reduction in SBP was essentially eliminated (116 +/- 5 to 113 +/- 5 mmHg). Author (revised)

A93-32783
LONGITUDINAL STUDY OF ASTRONAUT HEALTH - MORTALITY IN THE YEARS 1959-1991
L. E. PETERSON, L. J. PEPPER, P. B. HAMM, and S. L. GILBERT (Kelsey-Seybold Clinic, Houston, TX) Radiation Research (ISSN 0033-7587) vol. 133, no. 2 Feb. 1993 p. 257-264.
Copyright

We conducted a historical cohort study of mortality among 195 astronauts who were exposed to space and medical sources of radiation between 1959 and 1991. Cumulative occupational and medical radiation exposures were obtained from the astronaut radiation exposure history data base. Causes of death were obtained from obligatory death certificates and autopsy reports that were on file in the medical records. There was a total of 20 deaths that occurred during the 32-year follow-up period of which 16 were due to accidents. The all-cause standardized mortality ratio (SMR) was 181 (95 percent confidence interval 110, 279). There was 1 cancer death in the buccal cavity and pharyngeal ICD-9 rubric whose occurrence was significantly beyond expectation. Mortality for coronary disease was 53 percent lower than expected (2 deaths; SMR = 47; 95 percent confidence limits 5, 168). The crude death rate for 12 occupationally related accidents was 445 deaths per 100,000 person-years and was an order of magnitude greater than accidental death rates in the mining industries. The SMR of 1346 for fatal accidents was significantly beyond expectation (16 deaths; 95 percent confidence limits 769, 2168) and was similar to SMRs for accidents among aerial pesticide applicators. The 10-year cumulative risk of occupational fatalities based on the exponential, Weibull, Gompertz, and linear-exponential distributions was 10 percent. Overall, it was found that astronauts are at a health disadvantage as a result of catastrophic accidents. Author

A93-32784
ACCELERATED HEAVY PARTICLES AND THE LENS. VIII - COMPARISONS BETWEEN THE EFFECTS OF ACUTE LOW DOSES OF IRON IONS (190 KEV/MICRONS) AND ARGON IONS (88 KEV/MICRONS)
D. J. BRENNER, C. MEDVEDOVSKY, Y. HUANG, and B. V. WORGUL (Columbia Univ., New York) Radiation Research (ISSN 0033-7587) vol. 133, no. 2 Feb. 1993 p. 198-203.
Copyright

The nature of the RBE-LET relationship for radiation-induced effects in vivo is not well known in the high-LET range above about 100 keV/microns. Here, we compare the cataractogenic effects of acute doses of 190 keV/microns iron ions on the eyes of rats with those of 88 keV/microns argon ions. The RBEs of the two radiations cannot be distinguished statistically, both being between 50 and 200 at our lowest dose of 0.01 Gy and decreasing to between 2 and 14 at our highest dose of 0.5 Gy; these values are consistent with results obtained in vivo, both for cataractogenesis and for oncogenesis. For this end point, therefore, the RBE-LET relationship probably varies very slowly between 88 and 190 keV/microns. On the basis of these studies with acute doses of 88 and 190 keV/microns particles, the detailed distribution in LET of the very high-LET galactic cosmic-ray dose to which astronauts in deep space are exposed may not be critical for the prediction of biological hazard. Such a conclusion might simplify the task of high-LET radiation risk estimation in space. Author

A93-32785* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TEMPORAL ANALYSIS OF THE OCTOBER 1989 PROTON FLARE USING COMPUTERIZED ANATOMICAL MODELS
L. C. SIMONSEN, F. A. CUCINOTTA, W. ATWELL, and J. E. NEALY (NASA, Langley Research Center, Hampton, VA) Radiation Research (ISSN 0033-7587) vol. 133, no. 1 Jan. 1993 p. 1-11.
Copyright

The GOES-7 time history data of hourly averaged integral proton fluxes at various particle kinetic energies are analyzed for the solar proton event that occurred between October 19 and 29, 1989. By analyzing the time history data, the dose rates which may vary over many orders of magnitude in the early phases of the flare can be estimated as well as the cumulative dose as a function of time. Basic transport calculations are coupled with detailed body organ thickness distributions from computerized anatomical models to estimate dose rates and cumulative doses to 20 critical body organs. For a 5-cm-thick water shield, cumulative skin, eye, and blood-forming-organ dose equivalents of 1.27, 1.23, and 0.41 Sv, respectively, are estimated. These results are approximately 40-50 percent less than the widely used 0- and 5-cm slab dose estimates. The risk of cancer incidence and mortality are also estimated for astronauts protected by various water shield thicknesses. Author

A93-32786
COMPARISON OF SPINAL HEALTH INDICATORS IN PREDICTING SPINAL STATUS IN A 1-YEAR LONGITUDINAL STUDY
M. ROSSIGNOL, M. LORTIE, and E. LEDOUX (McGill Univ., Montreal, Canada) Spine (ISSN 0362-2436) vol. 18, no. 1 Jan. 1993 p. 54-60.
Copyright

A 1-year longitudinal study was performed to assess and compare the predictive qualities of spinal health indicators (excluding the cervical spine) among aircraft assembly workers having at least 1 year seniority in a large assembly plant. Ten health indicators were compared to determine their sensitivity and predictive power with regard to back compensation and absenteeism in 12 months follow-up, and the presence of any limitation at work due to the back, or symptoms to the back at the end of the interval. The initial response to a self-administered questionnaire was obtained from 269 male workers, of whom 205 (76.2 percent) completed the follow-up questionnaire. Initial prevalence of symptoms to the back was 42.3 percent, limitation in performing at work was 28.1 percent, consultation of a health professional was 7.3 percent, and a history of compensation for the back (ever) was reported by 30.4 percent. During the year of follow-up, 16 (6 percent) of the 269 workers initially enrolled were granted 17 compensated episodes. Of the 205 workers who responded to the follow-up, 33 (16.1 percent) have been absent from work (with or without compensation) because of their back. The presence, at the beginning of the study, of a limitation in performing at work or in activities of daily living and a history of compensation (ever) were the three indicators independently

associated with the occurrence of compensation or absenteeism (total work disability) related to a back problem during the following year. Author (revised)

A93-32787
UNCONSCIOUSNESS IN FLIGHT AND ITS PREVENTION
J. ERNSTING Medical Society of London, Transactions (ISSN 0076-6011) vol. 107 1991 p. 12-20.
Copyright

The physiological mechanism underlying two of the most potent causes of loss of consciousness in flight, viz. hypoxic hypoxia and exposure to rapid onset of high +Gz accelerations have been explored in this paper, principally using experimental work conducted at the Royal Air Force Institute of Aviation Medicine. The influence of the composition of the gas breathed before and after sudden decompression of the pressure cabin of an aircraft at high altitude has been described together with the physiological basis of the present standards for preventing disturbances of performance due to hypoxia following rapid decompression. The value and limitations of pressure breathing with oxygen at high pressures in preventing hypoxia on exposure to altitudes above 40,000 feet have been discussed together with the series of partial pressure suits used in the Royal Air Force. The mechanisms and occurrence of G-induced loss of consciousness in pilots of combat aircraft have been reviewed. The increasing likelihood of loss of consciousness due to G in new very agile combat aircraft is considered together with the limitations of the standard methods of enhancing G tolerance. The adoption and development of pressure breathing together with chest counterpressure and extended-cover G trousers which provide excellent protection against high levels of acceleration are described. Author

N93-22630*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CREW HEALTH
ROGER D. BILLICA *In* NASA, Washington, Space Station Freedom Utilization Conference p 293-299 1992
Avail: CASI HC A02/MF A04

Crew health concerns for Space Station Freedom are numerous due to medical hazards from isolation and confinement, internal and external environments, zero gravity effects, occupational exposures, and possible endogenous medical events. The operational crew health program will evolve from existing programs and from life sciences investigations aboard Space Station Freedom to include medical monitoring and certification, medical intervention, health maintenance and countermeasures, psychosocial support, and environmental health monitoring. The knowledge and experience gained regarding crew health issues and needs aboard Space Station Freedom will be used not only to verify requirements and programs for long duration space flight, but also in planning and preparation for Lunar and Mars exploration and colonization. Author (revised)

N93-22655*# General Dynamics Corp., San Diego, CA. Space Systems Div.
CANDIDATE TECHNOLOGIES FOR THE INTEGRATED HEALTH MANAGEMENT PROGRAM Final Report, 30 Oct. 1992 - 26 Feb. 1993
NEAL F. JOHNSON and FRED H. MARTIN 26 Feb. 1993 16 p
(Contract NASA ORDER H-18763-D)
(NASA-CR-192339; NAS 1.26:192339; REPT-93H-C-006) Avail: CASI HC A03/MF A01

The purpose of this report is to assess Vehicle Health Management (VHM) technologies for implementation as a demonstration. Extensive studies have been performed to determine technologies which could be implemented on the Atlas and Centaur vehicles as part of a bridging program. This paper discusses areas today where VHM can be implemented for benefits in reliability, performance, and cost reduction. VHM Options are identified and one demonstration is recommended for execution. Derived from text

N93-22774# Los Alamos National Lab., NM.
ADAPTIVE FILTERS FOR MONITORING LOCALIZED BRAIN ACTIVITY FROM SURFACE POTENTIAL TIME SERIES
M. E. SPENCER and R. M. LEAHY 1992 7 p Presented at the 26th Annual Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, 25-30 Oct. 1992
(Contract W-7405-ENG-36)
(DE93-003795; LA-UR-92-3645; CONF-9210231-3) Avail: CASI HC A02/MF A01

We address the problem of processing electroencephalographic (EEG) data to monitor the time series of the components of a current dipole source vector at a given location in the head. This is the spatial filtering problem for vector sources in a lossy, three dimensional, zero delay medium. Dipolar and distributed sources at other than the desired location are cancelled or attenuated with an adaptive linearly constrained minimum variance (LCMV) beamformer. Actual EEG data acquired from a human subject serves as the interference in a case where the desired source is simulated and superimposed on the actual data. It is shown that the LCMV beamformer extracts the desired dipole time series while effectively canceling the subjects interference. DOE

N93-23410*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TWO TECHNIQUES FOR MEASURING LOCOMOTION IMPACT FORCES DURING ZERO G
MICHAEL C. GREENISEN, RICHARD A. SMITH (McDonnell-Douglas Space Systems Co., Houston, TX.), GLENN K. KLUTE, and JAMES B. MCCAULLEY (McDonnell-Douglas Space Systems Co., Houston, TX.) Apr. 1993 6 p
(NASA-TP-3305; S-699; NAS 1.60:3305) Avail: CASI HC A02/MF A01

A load-cell-instrumented treadmill mated to a Kistler force plate was used to investigate two methods of force measurement instrumentation during treadmill ambulation in zero g, created by parabolic flight on NASA's KC-135 aircraft. Current spaceflight treadmills do not have adequate instrumentation to determine the resultant foot impact force applied during restrained ambulation. Accurate measurement of foot-ground reaction forces is critical in attaining proper one-g loading, therefore ensuring proper musculoskeletal conditioning. Treadmill instrumentation and force plate measurements were compared for frequency response and linearity. Locomotion impact data were also collected under one-g laboratory settings and in Keplerian flight. The first resonant frequency for both techniques was found to be well above the primary frequency content of the locomotive forces. Peak impact forces measured by the two systems compared to within 10 percent. Author

N93-23414# Construcciones Aeronauticas S.A., Madrid (Spain).
TOBACCO AND HEALTH OF THE PILOT [TABACO Y SALUD EN EL PILOTO]
FRANCISCO FERNANDEZMUNOZ 1991 5 p In SPANISH Repr. from Revista de Aeronautica y Astronautica, May 1991 p 590-594
(ETN-93-93693) Avail: CASI HC A01/MF A01

A report on tobacco and how its effects relate to pilots is presented. Special characteristics of tobacco habits are discussed: voluntariness, addiction, noxiousness, and reversibility. Statistics on the increase in tobacco consumption in relation to nicotine level reduction, and mortalities related to smoking, are given. ESA

N93-23459# Kent State Univ., OH.
STUDY OF SCN NEUROCHEMISTRY USING IN VIVO MICRODIALYSIS IN THE CONSCIOUS BRAIN: CORRELATION WITH CIRCADIAN ACTIVITY RHYTHMS Final Report, 1 Nov. 1989 - 31 Oct. 1992
J. D. GLASS, U. E. HAUSER, W. RANDOLPH, S. FERRIERA, and M. A. REA 29 Dec. 1992 14 p
(Contract AF-AFOSR-0047-90)
(AD-A259803; AFOSR-93-0031TR) Avail: CASI HC A03/MF A01

The central aim of this research is to provide information on

the neurochemical processes that underlie the generation and entrainment of mammalian circadian rhythms. The studies are centered around the newly-developed in vivo brain microdialysis technique for assessing the daily patterns of neurotransmitter release in the suprachiasmatic nuclei (SCN) of freely-behaving hamsters. During the funded period, this approach yielded several new findings related to the activities of serotonergic and excitatory amino acid systems in the SCN. Specifically, it was found that: there are daily variations in extracellular concentrations of 5-HIAA and glutamate in the SCN, with highest levels occurring at night; the daily release pattern of glutamate, but not serotonin, in the SCN is circadian in nature; the rhythm in glutamate measured in SCN microdialysate is based upon a non-synaptic, calcium-dependent mechanism and does not appear to be directly linked to the expression of locomotory behavior; and serotonergic transmission suppresses glutamate in SCN microdialysate, an effect possibly related to a modulatory effect of serotonin on glutamate release in the SCN. This also may be closely related to our finding that serotonin blocks light-induced Fos protein expression in the SCN. GRA

N93-23734*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMPARISON OF TOTAL BODY WATER ESTIMATES FROM O-18 AND BIOELECTRICAL RESPONSE PREDICTION EQUATIONS
LINDA H. BARROWS (Krug Life Sciences, Inc., Houston, TX.), L. DANIEL INNERS (Krug Life Sciences, Inc., Houston, TX.), MARCELLA D. STRICKLIN (Krug Life Sciences, Inc., Houston, TX.), PETER D. KLEIN (Baylor Univ., Dallas, TX.), WILLIAM W. WONG (Baylor Univ., Dallas, TX.), and STEVEN F. SICONOLFI Apr. 1993 11 p
(NASA-TP-3299; S-696; NAS 1.60:3299) Avail: CASI HC A03/MF A01

Identification of an indirect, rapid means to measure total body water (TBW) during space flight may aid in quantifying hydration status and assist in countermeasure development. Bioelectrical response testing and hydrostatic weighing were performed on 27 subjects who ingested O-18, a naturally occurring isotope of oxygen, to measure true TBW. TBW estimates from three bioelectrical response prediction equations and fat-free mass (FFM) were compared to TBW measured from O-18. A repeated measures MANOVA with post-hoc Dunnett's Test indicated a significant (p less than 0.05) difference between TBW estimates from two of the three bioelectrical response prediction equations and O-18. TBW estimates from FFM and the Kushner & Schoeller (1986) equation yielded results that were similar to those given by O-18. Strong correlations existed between each prediction method and O-18; however, standard errors, identified through regression analyses, were higher for the bioelectrical response prediction equations compared to those derived from FFM. These findings suggest (1) the Kushner & Schoeller (1986) equation may provide a valid measure of TBW, (2) other TBW prediction equations need to be identified that have variability similar to that of FFM, and (3) bioelectrical estimates of TBW may prove valuable in quantifying hydration status during space flight. Author

N93-23984# Defence Research Establishment, Ottawa (Ontario).
AFTERRISE: DEEP BODY TEMPERATURE FOLLOWING EXERCISE Technical Note
S. TUCK and A. A. KEEFE Apr. 1992 18 p
(AD-A259887; DREO-92-8) Avail: CASI HC A03/MF A01

The continued increase in rectal temperature seen after exercising in the heat is studied. Also, during recovery, the effects of posture and clothing during recovery, and temperature of the recovery room were examined. Five men exercised at a moderate intensity of 35 C and 50 percent relative humidity (RH) until their rectal temperatures reached 38.5 C. All subjects then recovered at a room temperature of 35 C or 22 C, while in a sitting or lying posture. These conditions were evaluated while the subject recovered wearing a Canadian Forces Chemical Warfare (CW) overgarment or light clothing (combat pants or shorts and a short sleeved shirt). This resulted in a total of 8 trials per subject. Rectal and skin temperatures were measured each minute during exercise and recovery. After exercise, rectal temperature increased above 38.5 C, however, this increase was slight. Posture and clothing as well as recovery environment affected the magnitude of this afterrise. It was concluded that the optimal condition in this experiment which minimized the post exercise temperature afterrise, was recovery at 22 C while sitting without the CW overgarment. GRA

N93-24009# Texas A&M Univ., College Station.
A LINEAR, TIME-VARYING SIMULATION OF THE RESPIRATORY TRACT SYSTEM Ph.D. Thesis
O. HERNANDEZ Nov. 1992 112 p
(Contract DE-FG05-88ER-60707)
(DE93-004515; DOE/ER-60707/T3) Avail: CASI HC A06/MF A02

These results show that regional deposition efficiencies of inhaled particles are highly dependent on the level of physical activity in all the spectrum of thermodynamic and aerodynamic aerosol particle sizes; also it was shown that for particles in the aerodynamic size range, the values of regional deposition efficiencies at the inner regions of the lung are highly dependent on age. In addition, the shape of regional deposition efficiency curves as a function of particle size have a similar behavior for all ages; thus, any variation of the airway geometry and respiratory physiological parameters such as tidal volumes and breathing frequencies due to age difference do not cause a change in the fundamental mechanisms of deposition. Thus, for all the cases of physical activity and age dependency, the deposition of ultrafine aerosol particles is highly enhanced by diffusive processes in all regions of the respiratory tract, and for very large aerosol size particles this behavior is repeated again due to impaction and sedimentation mechanisms. Although the results presented at this work, are the result of computer simulations based on different sources of experimental data, the structure of the computer simulation code BIODEP is flexible enough to the acquisition of any kind of new experimental information in terms of biokinetic analysis and regional deposition parameters. In addition, since the design of BIODEP was intended for easy access to the users, then with exception of the subroutine DIVPAG, at this moment, the modular design of BIODEP using FORTRAN 77 allows the implementation of all the subroutines of BIODEP to be used in an interactive mode with any microcomputer. DOE

N93-24021# Army Research Inst. of Environmental Medicine, Natick, MA.
SUSTAINING HEALTH AND PERFORMANCE IN THE COLD: A POCKET GUIDE TO ENVIRONMENTAL MEDICINE ASPECTS OF COLD-WEATHER OPERATIONS
A. J. YOUNG, D. E. ROBERTS, D. P. SCOTT, J. E. COOK, and M. Z. MAYS Dec. 1992 72 p
(AD-A259625; ARIEM-TN-93-2) Avail: CASI HC A04/MF A01

This technical note is a reformatted and slightly revised version of USARIEM Technical Note 92-2 - Sustaining Health and Performance In the Cold: Environmental Medicine Guidance for Cold-Weather Operations, July 1992. This pocket-sited version of the Technical Note reviews how the environment can impact an soldier health and performance during cold-weather. GRA

N93-24088# Federal Aviation Administration, Oklahoma City, OK. Civil Aeromedical Inst.
SURVEY OF AVIATION MEDICAL EXAMINERS: INFORMATION AND ATTITUDES ABOUT THE PRE-EMPLOYMENT AND PRE-APPOINTMENT DRUG TESTING PROGRAM Final Report
JENNIFER G. MYERS Mar. 1992 42 p
(Contract FAA PROJ. AM-C-90/91-HRR-122)
(DOT/FAA/AM-92/15) Avail: CASI HC A03/MF A01

Aviation medical examiners who are designated to collect urine specimens were surveyed to collect information and assess attitudes about different aspects of the pre-employment and pre-appointment drug testing program. Fifty-seven percent of the sample responded to the survey. Respondents were generally

positive about the custody and control form, the amount of information received about the collection kits and the drug testing program, and the contacts they had with the agency medical staff. However, only about half reported they had been informed of drug testing program changes. Accurate completion of custody and control forms and lack of training were cited most often as casual factors in the occurrence of errors in the specimen collection process and few had actually received information on their error rate in specimen collections. Recommendations were made to: (1) review the custody and control form for possible improvement that may reduce errors; (2) restrict the number of AME's designated to collect specimens; (3) provide training classes, materials, or videotapes, especially for newly designated AME's, and (4) clarify the alcohol and drug abatement program manager's position prior to a decision about the organizational location of the manager.
Author

N93-24092# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany). Abt. Luft- und Raumfahrtpsychologie.
STRESS RESISTANCE AS A DIAGNOSTIC CATEGORY IN AIR TRAFFIC CONTROLLER SELECTION Ph.D. Thesis - Hamburg Univ. [PSYCHISCHE BELASTBARKEIT ALS DIAGNOSTISCHE KATEGORIE IN DER EIGNUNGSAUSWAHL VON FLUGLOTSENANWAERTERN]
MANFRED BARBARINO Mar. 1992 173 p In GERMAN
(ISSN 0939-2963)
(DLR-FB-92-13; ETN-93-93572) Avail: CASI HC A08/MF A02; DLR, Wissens chafliches Berwichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The assessment of stress resistance in the selection of applicants for air traffic control, is addressed. Stress resistance was evaluated as a multivariate diagnosis of reactivity of stress reactions (behavioral observations, self ratings of mood, peripheral physiological parameters, and cortisol in saliva). The reaction data was collected during a computer based air traffic control test. Most of the subjects showed stress reactions elicited by the test. In order to improve the assessment of stress resistance the formation of a performance strain index was recommended, which can identify different performance strain types when self ratings of mood, behavioral, and performance data are included. ESA

N93-24093# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abt. Unterwassermedizin.
EVOKED BRAIN POTENTIALS AS INDICATORS OF A CENTRAL NERVOUS IMPAIRMENT IN A SIMULATED SATURATION DIVE TO 560 M Ph.D. Thesis - Duesseldorf Univ. [EVOZIERTE HIRNPOTENTIALE ALS INDIKATOREN FUER DIE ZENTRALNERVOESE BEEINTRAECHTIGUNG IN EINEM SIMULIERTEN SAETTIGUNGSTAUCHEXPERIMENT BIS 560 M TIEFE]
JUERGEN LORENZ Jun. 1992 76 p In GERMAN
(ISSN 0939-2963)
(DLR-FB-92-14; ETN-93-9357363) Avail: CASI HC A05/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Posfach 90 60 58, 5000 Cologne, Germany, HC 18.50 deutsche marks

Deep saturation dives which can lead to a complex central nervous system disorder, known as HPNS (High Pressure Neurological Syndrome), are addressed. In a dry chamber dive using helium-oxygen as the breathing gas, early and late auditory evoked potentials were repeatedly recorded in two divers. Prolonging the latencies of waves 3 and 5 within the Brainstem Auditory Evoked Potentials (BAEP) correlated highly with vestibular and motor signs of HPNS at 525 m during compression. It is assumed that the ponto-mesencephale brainstem is the primary locus of the disorder because wave 1, which indicates the response of the auditory nerve, was nearly unchanged. Clinical HPNS signs largely disappeared during isopression at 545 m, as did BAEP changes. Therefore, not absolute pressure by excessive compression rate at critical depth range was probably the most important factor. Increasing prolongation of reaction time was observed in the Sternberg Memory Search Task (MST) until 545 m. The effect was dependent on number of letters to be memorized, yielding an increase in the 'slope' parameter of Sternberg's model. This points to an increase in memory scanning rate. Latency of P300 wave of the late potentials was prolonged in a similar way, if the eliciting stimuli were embedded in a secondary task performed in combination with MST. It is concluded that the environmental conditions of extreme diving depths, impair primarily the function of 'working memory' among the components of higher brain functions. Its variable expenditure is measurable by P300 values.
ESA

N93-24238# Brown Univ., Providence, RI. Inst. for Brain and Neural Systems.
THEORY OF SYNAPTIC PLASTICITY IN VISUAL CORTEX
NATHAN INTRATOR, MARK F. BEAR, LEON N. COOPER, and MICHAEL A. PARADISO 20 Jan. 1993 23 p
(Contract DAAL03-91-G-0325)
(AD-A260322; TR-16; ARO-29170.2-LS) Avail: CASI HC A03/MF A01

A short account is given of the theory of synaptic plasticity: assumptions, consequences, comparison with experiment, and statistical properties. In addition a framework for comparison with other theoretical ideas is presented. GRA

N93-24247# Texas Univ., Houston. Dept. of Neurobiology and Anatomy.
ANALYSIS AND SYNTHESIS OF ADAPTIVE NEURAL ELEMENTS AND ASSEMBLIES Annual Report, 1 Oct. 1991 - 30 Sep. 1992
JOHN H. BYRNE 14 Dec. 1992 8 p
(Contract AF-AFOSR-0027-91)
(AD-A259954; AFOSR-93-0028TR) Avail: CASI HC A02/MF A01

Between October 1, 1991 and September 30, 1992, progress was made in four areas. First, the capabilities of SNNAP, a general purpose Simulator for Neural Networks and Action Potentials, were enhanced by incorporating mathematical descriptions of intracellular levels of Ca2(+) and second messenger systems, which in turn modulate membrane conductances. Second, cellular mechanisms underlying operant conditioning were investigated in simulations of neural networks with biologically realistic properties. In one neural network, a learning rule (activity-dependent neuromodulation), which has been proposed as a cellular mechanism for classical conditioning, was demonstrated to support many features of operant conditioning. A second neural network was developed that simulates the biophysical properties of the neurons and synaptic interactions in a central pattern generator (CPG) underlying aspects of feeding behavior - a behavior that can be modified by operant conditioning. Third, experiments characterized the modulatory actions of transmitters on the synaptic connections and the intrinsic biophysical properties of neurons in the feeding CPG. Fourth, extensions were made to the single-cell model of associative learning by incorporating quantitative descriptions of the modulation of membrane currents by 5-HT.
GRA

N93-24354# Institute of Biomedical Problems, Moscow (USSR).
PHYSIOLOGICAL EXPERIMENTS WITHIN THE PROJECT AUSTROMIR
I. C. PESTOV *In* ESA, *Environment Observation and Climate* Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 97-100 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The ten medical experiments performed during the joint Soviet-Austrian mission to the orbital Space Station Mir are addressed. Their scientific aims are discussed and their time requirements and experimenters addressed. The aim was to gain new scientific material to assess the influencing factors of a space flight on the human motoric functions, the senses, the blood circulation, higher psychological functions, the volume regulation, the genetic functions, and on an advanced system for the dosimetric control of a space flight. The selected range of tasks covered most topical problems in the field of space medicine and

gravitational biology of interest for the general health management both in theory and practice. The results of the research performed improve the picture of the physiological changes which occur during the adaptation of man to weightlessness. This information furthermore allows us to prepare recommendations for a system for the medical supervision of the state of the cosmonaut during the flight. ESA

N93-24363# Wien Univ. (Austria). Dept. of Sports and Exercise Physiology.

DEVELOPMENT AND IMPLEMENTATION OF THE MOTOMIR EXPERIMENT ON THE MIR SPACE STATION

N. BACHL, R. BARON, I. KOZLOVSKAYA (Institute of Biomedical Problems, Moscow, USSR.), K. H. TSCHAN, M. MOSSAHEB (FDP, Inc., Vienna, Austria.), W. BUMBA (Bumba, W. Space Producing, Inc., Vienna, Austria.), I. KHARITONOV (Institute of Biomedical Problems, Moscow, USSR.), R. ALBRECHT (European Southern Observatory, Garching, Germany.), and F. HILDEBRAND (Landessportbund Sachsen, Leipzig, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 147-151 Jul. 1992

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The MotoMir experiment, developed in the framework of the Austrian-Russian space program, is described. The purpose was to investigate the force-angle velocity relationship of human musculature in and against a predetermined pattern of translatoric movement (concentric and eccentric exercise), and the correlation of the results with neurophysiological data obtained by integrated surface Electromyogram (EMG). A further goal was to answer questions pertaining to muscular fatigue in the zero gravity environment, contrasting force decrease with different EMG parameters during different work modes. The ultimate purpose was to develop concepts which can be applied to the training of astronauts, of athletes, and to the rehabilitation after injuries. Hardware development was based on an existing ground based prototype ergometer with which clinical tests and test with athletes were conducted. Extensive redesign was necessary which resulted in a firmware controlled ergometer with design characteristics allowing the optical use of the zero gravity environment. The following tests were performed: a cyclic leg and arm work in concentric and eccentric work mode depending on different angles and angle velocities; cyclic leg and arm work in three different submaximal intensities, both in eccentric and concentric work mode. Methods, data acquisition, data analysis, and preliminary results are discussed and compared with preflight and postflight investigations. ESA

N93-24367# Technische Univ., Graz (Austria). Physiologisches Inst.

MONITORING OF CARDIOVASCULAR PARAMETERS DURING THE AUSTROMIR SPACE FLIGHT

M. MOSER, E. GALLASCH, D. RAFOLT, G. JERNEJ, C. KEMP, E. MAIER, T. KENNER, R. BAYEVSKIJ (Institute of Biomedical Problems, Moscow, USSR.), I. FUNTOWA (Institute of Biomedical Problems, Moscow, USSR.), and Y. AVAKYAN (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 169-174 Jul. 1992

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Two experiments performed during the Austrian-Russian space flight AustroMir in Oct. 1991 to investigate the physiological changes in the circulation under the conditions of microgravity are described: pulstrans, performed during the day, a complex experiment consisting of rest, variations of arm positions, handgrip ergometry and breathing maneuvers; and sleep, developed to observe the cosmonauts circulatory system during the night. The goal of the study was the monitoring of the cosmonauts adaptation to microgravity and the investigation of the physical properties of arm and leg arteries. The observed physiological changes in microgravity compared to upright position range from slightly decreased heat rate, decreased pulse wave velocity in the leg arteries and shifts in the cardiopulmonary coordination to changes in the heat orientation resulting in a marked increase in electrocardiogram amplitude. Arterial pulse transmission shows decreased peripheral resistance in microgravity. Post flight, a decrease of muscular strength and an obvious deconditioning of the circulation takes place, which results in an increase in heart rate above preflight values during day and night and in a shift in pulse-respiration quotient during sleep. ESA

N93-24370# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna.

INFLUENCE OF MICROGRAVITY ON IMMUNE SYSTEM AND GENETIC INFORMATION

H. TUSCHL, R. KOVAC, W. KLEIN, E. OTT, Y. I. VORONKOV (Institute of Biomedical Problems, Moscow, USSR.), and M. KAIDAKOW (Institute of Biomedical Problems, Moscow, USSR.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 187-191 Jul. 1992

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The effect of spaceflight on lymphocytes of the peripheral blood was investigated in the Austian cosmonaut flying the Austro-Soviet mission 'AustroMir'. Blood was sampled before and after flight, and the following parameters studied: quantities of lymphocytic subsets (T cells, helper cells, suppressor cells, B cells, and natural killer cells); mitogenic stimulation of lymphocytes, DNA (deoxyribonucleic acid) synthesis and expression of Interleukin 2 receptor; and structrural modification of DNA, unscheduled DNA synthesis, and sister chromatid exchanges. Besides reducing the number of natural killer cells, spaceflight caused an impairment of lymphocyte activity and a slight modification of DNA structure. Four weeks after flight, control values were reestablished, indicating efficient repair mechanisms. ESA

N93-24386# Deutsche Sporthochschule, Cologne (Germany). Physiologisches Inst.

COLUMBUS PAYLOAD REQUIREMENTS IN HUMAN PHYSIOLOGY

JUERGEN STEGEMANN *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 281-283 Jul. 1992

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The phase A study report provided by scientists of different fields of physiology who were asked to provide a 'science study' for the Columbus payload requirements, is presented. The report concerns the Anthrolab, a laboratory that covers all presently known research challenges in the area. Anthrolab is more or less an improvement of the Anthrorack to be flown on the German Spacelab mission D-2 and on the Columbus precursor flight E-1. Beside the present Anthropack design Antrolab also will provide subelements for vestibular, neurophysiological, and biomechanical research. The main subelements and major devices of Anthrolab are listed: respiratory monitoring system, ultrasound monitoring system, liquid monitoring and processing system, neuromuscular laboratory, stimulation devices. Some scientific areas which might be investigated using this equipment are depicted. ESA

N93-24398# Nagoya Univ. (Japan). Research Inst. of Environmental Medicine.

TELESCIENCE TESTBEDDING FOR PHYSIOLOGICAL EXPERIMENTS UNDER HYPOBARIC HYPOXIC CONDITIONS

SATORU WATANABE, MASAMICHI YAMASHITA (Tokyo Univ., Sagamihara, Japan.), TAKATOSHI SHOJI (Kawasaki Heavy Industries Ltd., Gifu, Japan.), HIROYUKI SUZUKI, SOKICHI SAKURAGI (Aichi Univ. of Education, Japan.), SHIGEO MORI, YOSHIROU WADA, and MITSUHIRO KOEDA (Chukyo Univ., Toyota, Japan.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight

(COSY-8): Utilisation of Earth Orbiting Laboratories p 341-346 Jul. 1992
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A testbed experiment is presented which explores the effect of telescience utilization in an experiment to test changes in work efficency under severe conditions. These severe conditions are provided through the hydrobaric and hypoxic environments of a decompression chamber. A psychological examination was performed using the Kraeplin test and scoring on a television game. The Continent Negative Variation (CNV) and alpha blocking activation at low atmospheric pressure was also examined. The last one was a variation of heart rate during exercise in such low pressure. Timelining of these experiments was optimized to reduce the total elapsed time. Two principal investigators share time and two operators who were subjects of the experiments at the same time. Response of CNV was preprocessed onboard to compress raw data for downlink. Performance to play a TV game and to conduct arithmetic calculation of the Kraepelin, test was investigated to evaluate the thinking power of the operators during the experiment run. It was learned that flexible management on timeline and crew care enhances scientific achievements in a great amount at the telescience situation. ESA

N93-24399# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Aerospace Medicine Inst.
CARDIOVASCULAR STRESS TEST WITH NON-INVASIVE TECHNIQUES
F. BAISCH, L. BECK, I. RETAT (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.), and M. SOELTER (Erno Raumfahrttechnik G.m.b.H., Bremen, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 347-352 Jul. 1992
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The Anthrorack Lower Body Negative Pressure Device (LBNPD) and multiple non invasive measurement devices are presented. These can be used for cardiovascular research, diagnostics, and training in space and on ground. The LBNPD can be operated as a standalone instrument. Computer operation provides, however, more flexibility. In both cases, safety measures prevent the overstraining of the test subjects. Early detection and prevention of cardiovascular degradation is a main commitment of health care in space and on ground. It ethically requires non invasive diagnosis. Combination of noninvasive methods with the LBNP stress yields a valid scenario. On line analysis of non invasively obtained biosignals must rely, due to the large amount of produced data, on a powerful signal analysis and validation system. The main component of such a scenario could be a multiprocessor computer system that efficiently reduces the data amount while increasing the medical information content. ESA

N93-24400# Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands). Product Centre.
A BODY MASS MEASUREMENT DEVICE BASED ON THE OSCILLATION PRINCIPLE
J. F. F. KLINKHAMER and F. BRECHIGNAC (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 353-357 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The study and development of a Body Mass Measurement Device (BMD) whose technical objectives aim at a repeatability of measurement better than +/- 100 grams with a compact instrument easy to operate, are reported. Assessment of the error sources by analysis and simulations resulted in the selection of the oscillation principle as the most promising concept to fulfill the requirements. Based on this choice, a breadboard was constructed which includes a parallel leaf spring mechanism combining two functions: spring elasticity and parallel guiding. With the further provision of a test set up designed to simulate microgravity in two horizontal dimensions, an experimental program was undertaken in order to gain a better understanding of the various error contributions, and to derive countermeasures for further improvement. The results presented strongly suggest that a body posture more compressed than the standing one will yield better performance; further meeting the requirements. ESA

N93-24420# California Univ., Berkeley. Dept. of Molecular Biology.
COMPUTER BASED ANALYSIS AND SYNTHESIS OF RETINAL FUNCTION Annual Report, 1 Feb. 1991 - 31 Jan. 1992
FRANK S. WERBLIN 22 Dec. 1992 5 p
(Contract AF-AFOSR-0196-91)
(AD-A260514; AFOSR-93-0027TR) Avail: CASI HC A01/MF A01

The vertebrate retina sequentially transforms patterns of neural activity through 5 separate, serially arranged sheets of cells. These neuronal patterns become increasingly complex at each successive layer. Our objective is to determine the parameters in space and time for the transfer functions that transform the patterns at successive layers. We have extracted the space and time constants for retinal processing from the physiological data taken from single cells at each retinal layer. These space-time parameters drive an image processing computer, the PIPE. The resulting program represents a tentative blueprint for design of a retina, and some of these values have been used by modelers to make artificial retinas, including the recently developed silicon retina. GRA

N93-24551*# University of South Florida, Tampa. Center for Engineering and Medical Image Analysis.
DIGITAL MAMMOGRAPHY, CANCER SCREENING: FACTORS IMPORTANT FOR IMAGE COMPRESSION
LAURENCE P. CLARKE, G. JAMES BLAINE (Washington Univ., Saint Louis, MO.), KUNIO DOI (Chicago Univ., IL.), MARTIN J. YAFFE (Toronto Univ., Ontario.), FAINA SHTERN (National Cancer Inst., Bethesda, MD.), G. STEPHEN BROWN (Research Triangle Inst., Research Triangle Park, NC.), DANIEL L. WINFIELD (Research Triangle Inst., Research Triangle Park, NC.), and MARIA KALLERGI (University of South Florida, Tampa.) *In* NASA. Goddard Space Flight Center, The 1993 Space and Earth Science Data Compression Workshop p 63-74 Apr. 1993
Avail: CASI HC A03/MF A02

The use of digital mammography for breast cancer screening poses several novel problems such as development of digital sensors, computer assisted diagnosis (CAD) methods for image noise suppression, enhancement, and pattern recognition, compression algorithms for image storage, transmission, and remote diagnosis. X-ray digital mammography using novel direct digital detection schemes or film digitizers results in large data sets and, therefore, image compression methods will play a significant role in the image processing and analysis by CAD techniques. In view of the extensive compression required, the relative merit of 'virtually lossless' versus lossy methods should be determined. A brief overview is presented here of the developments of digital sensors, CAD, and compression methods currently proposed and tested for mammography. The objective of the NCI/NASA Working Group on Digital Mammography is to stimulate the interest of the image processing and compression scientific community for this medical application and identify possible dual use technologies within the NASA centers. Author

N93-24590# Energetics, Inc., Columbia, MD.
POTENTIAL HUMAN HEALTH EFFECTS ASSOCIATED WITH POWER FREQUENCY ELECTRIC AND MAGNETIC FIELDS Status Report, Jun. 1991 - Jun. 1992
Aug. 1992 201 p Sponsored by Maryland Power Plant Research Program, Annapolis
(Contract PR-91-007-008)
(PB93-132678; PPRP/PPSE-T-37) Avail: CASI HC A10/MF A03

Over the past 20 years, a number of scientific studies have suggested that exposure to 60-hertz (Hz) electric and magnetic field (EMF) may be associated with human health effects, including

an increased risk of cancer. Common sources of 60-Hz electric and magnetic fields include power lines, electrical wiring, ground return currents, and appliances. Some epidemiology studies have found a link between EMF exposure and certain types of cancer; however, the results of these studies are not conclusive. The scientific research that has been conducted to date (including epidemiology studies and research conducted on whole animals and cells, as well as human volunteers) has been unable to positively prove or disprove the existence of significant health effects from EMF. This report presents the major results, activities, and findings of current and ongoing EMF-related health effects research covering the time period June 1991 to May 1992. The report reviews research results from epidemiology studies, human studies, whole animal investigations, cell-level laboratory studies, exposure assessments, and engineering studies. Author

N93-24738*# Monterey Technologies, Inc., Carmel, CA.
AUTONOMIC PHYSIOLOGICAL DATA ASSOCIATED WITH SIMULATOR DISCOMFORT
JAMES C. MILLER, THOMAS J. SHARKEY, GLENNA A. GRAHAM, and MICHAEL E. MCCAULEY Feb. 1993 28 p Sponsored by U.S. Army Aerroflight Dynamics Directorate
(Contract NAS2-12927)
(NASA-CR-177609; A-93026; NAS 1.26:177609; USAATCOM-TR-92-A-001) Avail: CASI HC A03/MF A01

The development of a physiological monitoring capability for the Army's advanced helicopter simulator facility is reported. Additionally, preliminary physiological data is presented. Our objective was to demonstrate the sensitivity of physiological measures in this simulator to self-reported simulator sickness. The data suggested that heart period, hypergastria, and skin conductance level were more sensitive to simulator sickness than were vagal tone and normal electrogastric activity.
Author (revised)

N93-24763*# Brown Univ., Providence, RI. Dept. of Pathology.
MECHANICAL STIMULATION OF SKELETAL MUSCLE MITIGATES GLUCOCORTICOID INDUCED DECREASES IN PROSTAGLANDIN SYNTHESIS
JOSEPH A. CHROMIAK and HERMAN H. VANDENBURGH 1993 35 p
(Contract NAG2-414)
(NASA-CR-193040; NAS 1.26:193040) Avail: CASI HC A03/MF A01

The glucocorticoid dexamethasone (Dex) induces a decline in protein synthesis and protein content of tissue cultured, avian skeletal muscle cells, and this atrophy is attenuated by repetitive mechanical stretch. Since the prostaglandin synthesis inhibitor indomethacin mitigated this stretch attenuation of muscle atrophy, the role of prostaglandins as growth modulators in these processes was examined. Dex at 10(exp -8) M reduced PGF(sub 2(alpha)) production 55 percent - 65 percent and PGE(sub 2) production 84 - 90 percent after 24 - 72 h of incubation in static cultures. Repetitive 10 percent stretch-relaxations of the non-Dex treated cultures increased PGF(sub 2(alpha)) efflux 41 percent at 24 h and 276 percent at 72 h and increased PGE(sub 2) production 51 percent at 24 h and 236 percent at 72 h. Mechanical stimulation of Dex treated cultures increased PGF(sub 2(alpha)) production 162 percent after 24 h, thus returning PGF(sub 2(alpha)) efflux to the level of non-Dex treated cultures. At 72 h, stretch increased PGF(sub 2(alpha)) efflux 65 percent in Dex treated cultures, but PGF(sub 2(alpha)) production was 45-84 percent less than non-Dex treated cultures. Mechanical stimulation of Dex treated cultures increased PGE(sub 2) production at 24 h, but not at 72 h. Dex reduced prostaglandin H synthase (PGHS) activity in the muscle cultures by 70 percent after 8 - 24 h of incubation, and mechanical stimulation increased PGHS activity of the Dex treated cultures by 98 percent. It is concluded that repetitive mechanical stimulation attenuates the catabolic effects of Dex on cultured skeletal muscle cells in part by reversing the Dex-induced declines in PGHS activity and prostaglandin production. Author (revised)

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A93-30239
TWO TYPES OF OCCLUSION CUES FOR THE PERCEPTION OF 3-D ILLUSORY OBJECTS IN BINOCULAR FUSION
MASANORI IDESAWA (Inst. of Physical and Chemical Research, Wako, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922) vol. 32, no. 1A/B Jan. 15, 1993 p. L75-L78. Research supported by Science and Technology Agency of Japan refs
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In three-dimensional (3D) space perceptual functioning of the human visual system, occlusion cues play an important role. Two types of occlusion cues in binocular fusion were postulated and investigated using the newly discovered 3D illusion. One type is called the contour occlusion cue, in which the visibility of occluded objects changes at the border where they pass beyond the occluding object contour. The second type is newly postulated and is named the bulky occlusion cue, which applies to volumetric occlusion, in which the visibility of occluded objects changes at the boundary where they pass through the object surface from the outside space to the inside space of the occluding object. These newly postulated and clarified occlusion cues are closely related to the visual perception of 3D-space in binocular viewing, and they are expected to provide clues to revealing the mechanism underlying the 3D-space perceptual ability of the human visual system. Author

A93-30277* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MULTICULTURAL FACTORS IN THE SPACE ENVIRONMENT - RESULTS OF AN INTERNATIONAL SHUTTLE CREW DEBRIEF
PATRICIA A. SANTY (Texas Univ., Galveston), ALBERT W. HOLLAND (NASA, Johnson Space Center, Houston, TX), LAURIE LOOPER (Krug Life Sciences, Inc., Houston, TX), and REGINA MARCONDES-NORTH (Universities Space Research Association, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. 196-200. refs
Copyright

There is increasing interest and concern about the multicultural and multinational factors which might negatively affect adjustment and performance of Space Station Freedom (SSF) crews, living and working for long periods of time in the space environment. To begin identifying potential problem areas, a crew debrief questionnaire (called an 'International Crew Debrief') was mailed to U.S. astronauts who flew on Shuttle missions between 1981-1990 with one or more crewmembers from other countries. There were 20 U.S. astronauts who flew on international space missions; 9 of these responded to the questionnaire, for a return rate of 45 percent. There were 42 incidents reported: 9 in the preflight period; 26 inflight; and 7 in the postflight period. Most of these incidents were rated as having a low or medium impact, but five of the inflight incidents were rated to have a 'high' mission impact. A number of causes for the problems were listed, and are discussed. Debrief respondents provided useful and timely recommendations on preflight training which may help facilitate the integration of multinational crews, and prevent multicultural or multinational factors from interfering with mission operations.
Author

A93-30440
'SCREENING-CONTROLLING' PSYCHOLOGICAL SELECTION SYSTEM FOR AIR FORCE PILOT CADET
HUI WANG (Inst. of Aviation Medicine, Beijing, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 271-276. In Chinese. refs

A macrocosmic program of the 'Screening-Controlling' Psychological Selection System (PCPSS) for Air Force Pilot Cadets was worked out. The studies involved the technique and method of a dual-task battery (DTB), interview, dual-task and biofeedback training (DTBFT). A total of 144 male·pilot cadets (MPC), 20-22 years, were tested using the computerized DTB for 22 min. Each of the 140 MPC was interviewed for 30 min. The reliability of scores was 0.91 (p is less than 0.01), the concurrent and predictive validity were 0.32 and 0.67 (p is less than 0.01) respectively. The above-mentioned methods were tried out in the selection of 9144 cadets. DTBFT was administered to 36 MPCs, for 30 min per person per day, for 15 days. The results indicated that there was a close relationship between DIBFT and flying scores, and DIBFT could be used for further selection of pilot cadets. Author

A93-30443
NEUROBEHAVIORAL TEST IN CIVIL AVIATION FLIGHT PERSONNEL
JI-GUANG CHEN (Anhui Medical Univ., Hefei, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 286-290. In Chinese. refs

The WHO Neurobehavioral Core Test Battery (NCTB), which assesses mood, attention/response speed, auditory memory, manual dexterity, perceptual-motor speed, visual perception/memory, and motor steadiness, was administered to 39 flight personnel and 31 nonflight personnel in civil aviation. Scores of simple reaction time, digit span, the Santa Anna manual dexterity test, pursuit aiming test, and comprehension, vocabulary and arithmetic tests of flight personnel in civil aviation were significantly lower than those of the control group. There were distinct statistical differences between the overall language scores as well. It is shown that with long-time high-altitude flight and the concomitant high mental strain, the neurobehavior of flight personnel could be affected, and fatigue could ensue. P.D.

A93-30456
HUMAN STEREOPSIS
ROBERT PATTERSON (Washington State Univ., Pullman) and WAYNE L. MARTIN (USAF, Armstrong Lab., Wright-Patterson AFB, OH) Human Factors (ISSN 0018-7208) vol. 34, no. 6 Dec. 1992 p. 669-692. refs
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This paper reviews much of the basic literature on stereopsis for the purpose of providing information about the ability of humans to utilize stereoscopic information under operational conditions. This review is organized around five functional topics that may be important for the design of many stereoscopic display systems: geometry of stereoscopic depth perception, visual persistence, perceptual interaction among stereoscopic stimuli, neurophysiology of stereopsis, and theoretical considerations. The paper concludes with the presentation of several basic ideas related to the design of stereoscopic displays. Author

A93-30928#
HUMAN FACTOR CONSIDERATIONS FOR THE FIRST LUNAR OUTPOST
AUREO F. ANDINO (Univ. of Puerto Rico, Rio Piedras) Feb. 1993 11 p. AIAA, AHS, and ASEE, Aerospace Design Conference, Irvine, CA, Feb. 16-19, 1993 refs
(AIAA PAPER 93-1014) Copyright

The paper discusses the design of a lunar outpost mission scenario (the First Lunar Outpost, FLO) currently being considered by NASA, in the framework of the human factors design philosophy. After considering various possible shapes and dimensions for the FLO, it is concluded that the design of the FLO habitat should be developed as a three-level vertical cylinder twenty four feet in diameter, adequate to house functions and living quarters of a crew of four for 45-day missions and still be within the Space Exploration Initiative limits of not more than 30 metric tons. Locomotions within the habitat module will require textured surfaces, bars for upper body control, and special furniture design. The paper also describes activities of future inhabitants of the FLO during a typical 24-hour period. I.S.

A93-31490
ON COCKPIT (CREW) RESOURCE MANAGEMENT [PROBLEMY GOSPODARKI ZASOBAMI INFORMACJI W ZALODZE]
JANUSZ MORAWSKI (Inst. Lotnictwa, Warsaw, Poland) Instytut Lotnictwa, Prace (ISSN 0509-6669) no. 131 1992 p. 30-55. In Polish. refs

Basic problems of crew (cockpit) resource management (CRM) in transport aircraft are surveyed in brief. The characteristic phenomenon referred to as 'crew effect' is defined and explained. Crew error vs. pilot error is discussed. The following methods of the CRM investigation are described: crew leader personality ('GRID') analysis; resource integration for crewed systems (RICS) model method; microcoding of communications, problem behavior graph analysis; and expert assessment (NASA/UT Checklist) procedure. Some future trends and intentions concerning the subject investigation are presented and discussed. Author

A93-31491
INFORMATION MANAGEMENT PROBLEMS AND THEIR INFLUENCE ON COCKPIT EQUIPMENT ARCHITECTURE OF TRANSPORT AIRCRAFT [PROBLEMY GOSPODARKI INFORMACJA W ARCHITEKTURZE WYPOSAZENIA KABIN SAMOLOTOW KOMUNIKACYJNYCH]
JANUSZ M. MORAWSKI (Inst. Lotnictwa, Warsaw, Poland) Instytut Lotnictwa, Prace (ISSN 0509-6669) no. 131 1992 p. 56-70. In Polish. refs

The paper deals with problems of acquisition and management of information in the cockpit of contemporary transport aircraft. Reader's attention is focused on some natural behavioral patterns of a flight crew. The human/crew-centered approach leads to some new insights into the mission itself, the latter understood as human interaction with complex dynamic process. Some new problems arise concerning cockpit architecture including both hardware and software. Principles of the so-called adaptive automation, based on flexible allocation of responsibilities and loads between the human-operator and the system, are sketched. Author

A93-32004 National Aeronautics and Space Administration, Washington, DC.
FLIGHT-PATH ESTIMATION IN PASSIVE LOW-ALTITUDE FLIGHT BY VISUAL CUES
ARTHUR J. GRUNWALD and S. KOHN (Technion - Israel Inst. of Technology, Haifa) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090) vol. 16, no. 2 Mar.-Apr. 1993 p. 363-370. Research supported by NASA refs
(Contract NAGW-1128)
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A series of experiments was conducted, in which subjects had to estimate the flight path while passively being flown in straight or in curved motion over several types of nominally flat, textured terrain. Three computer-generated terrain types were investigated: (1) a random 'pole' field, (2) a flat field consisting of random rectangular patches, and (3) a field of random parallelepipeds. Experimental parameters were the velocity-to-height (V/h) ratio, the viewing distance, and the terrain type. Furthermore, the effect of obscuring parts of the visual field was investigated. Assumptions were made about the basic visual-field information by analyzing the pattern of line-of-sight (LOS) rate vectors in the visual field. The experimental results support these assumptions and show that, for both a straight as well as a curved flight path, the estimation accuracy and estimation times improve with the V/h ratio. Error scores for the curved flight path are found to be about 3 deg in visual angle higher than for the straight flight path, and the sensitivity to the V/h ratio is found to be considerably larger. For the straight motion, the flight path could be estimated successfully from local areas in the far field. Curved flight-path estimates have to rely on the entire LOS rate pattern. Author (revised)

A93-32780
RESULTS OF A STRUCTURED PSYCHIATRIC INTERVIEW TO EVALUATE NASA ASTRONAUT CANDIDATES
P. A. SANTY, J. ENDICOTT, D. R. JONES, R. M. ROSE, J.

PATTERSON, A. W. HOLLAND, D. M. FAULK, and R. MARSH (Texas Univ., Galveston) *Military Medicine* (ISSN 0026-4075) vol. 158, no. 1 Jan. 1993 p. 5-9.
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One-hundred-six astronaut applicants who had passed initial screening were evaluated for Axis I and Axis II DSM-III-R diagnoses using a structured psychiatric interview. Nine of 106 candidates (8.5 percent) met diagnostic criteria for six Axis I (including V-code), or Axis II disorders. The use of the NASA structured interview was effective in identifying past and present psychopathology in a group of highly motivated and healthy astronaut applicants. This was the first time that a structured interview had been used in such a setting for this purpose. The methodology described is applicable to any situation where the presence or history of psychopathology requires evaluation for job selection (e.g. pilot selection). Author

A93-32782* National Aeronautics and Space Administration. *Ames Research Center, Moffett Field, CA.*
VISUAL AND SOMESTHETIC INFLUENCES ON POSTURAL ORIENTATION IN THE MEDIAN PLANE
K. NEMIRE and M. M. COHEN (NASA, Ames Research Center, Moffett Field, CA) Perception and Psychophysics (ISSN 0031-5117) vol. 53, no. 1 Jan. 1993 p. 106-116.
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We investigated optic and somesthetic contributions to perceived body orientation in the pitch dimension. In a within-subject factorial design, each of 12 subjects attempted to set his/her body erect or 45 degrees back from erect while restrained in a movable bed surrounded by an adjustable box. The box provided a visual environment consisting of either a grid pattern, two luminous lines, or complete darkness. Both the grid pattern and the luminous lines were effective at biasing settings of body position when the box was pitched; the pitched grid was more effective than the pitched lines. Although the pitch of the box influenced orientation to both goals, the effect was greater for the diagonal goal than for the erect goal. We present a model of postural orientation in the median plane that involves vestibular, somatosensory, and visual inputs. Author

A93-32788
SHAPE DISCRIMINATION AND THE JUDGEMENT OF PERFECT SYMMETRY - DISSOCIATION OF SHAPE FROM SIZE
D. REGAN and S. J. HAMSTRA (*York Univ., North York, Canada*) Vision Research (ISSN 0042-6989) vol. 32, no. 10 Oct. 1992 p. 1845-1864.
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We measured the accuracy with which subjects judged that a square or circle was perfectly symmetrical i.e. that aspect ratio (a/b) was exactly unity (where a and b were, respectively, the vertical and horizontal dimensions). Errors were remarkably small, ranging from 0.7 to 0.4 percent for the judgement of squareness and from 1.4 to less than 0.1 percent for the judgement of circularity. Precision in judging aspect ratio was measured by requiring subjects to judge whether the aspect ratio (a/b)TEST of a test rectangle was greater or less than the aspect ratio (a/b)REF of a reference rectangle. Similar measurements were made for elliptical targets. To ensure that subjects based judgements on aspect ratio rather than a, b or (a-b), the area of each successive presentation was varied randomly. The just-discriminable percentage change of aspect ratio was as low as 1.6 percent at (a/b)REF = 1.0 (i.e. for a square or circular reference), and rose progressively as (a/b)REF was made progressively larger or smaller than 1.0. For both rectangles and ellipses, the best value of aspect ratio discrimination threshold corresponded to a precision of encoding a and b of 14 sec arc or better. In further experiments, the method of constant stimuli was used to measure an aspect ratio aftereffect produced by adapting separately to rectangles of (a/b)ADAPT equal to 1.5, 1.0 and (1/1.5). Similar aftereffects were obtained whether the area of the test stimulus was fixed or varied randomly from trial to trial, or whether the test stimulus was rectangular or elliptical. Author (revised)

N93-23479# York Univ. (Ontario).
SENSORY SENSITIVITIES AND DISCRIMINATIONS AND THEIR ROLES IN AVIATION Annual Report, 1 Nov. 1991 - 31 Oct. 1992
D. REGAN 30 Nov. 1992 136 p
(Contract AF-AFOSR-0080-91)
(AD-A259742; AFOSR-92-0997TR) Avail: CASI HC A07/MF A02

Evidence that intersubject differences in the ability to process motion-defined (MD) shape are not predicted by the ability to process luminance-defined (LD) shape, that motion is processed by hierarchical manner, that discrimination and detection can be dissociated for MD form, and that spatial discrimination for MD and LD form are not entirely mediated by the same mechanism is as follows. Reducing presentation duration or dot lifetime from 1.0 to 0.1 sec progressively reduced the visibility of a MD bar, but did not reduce orientation discrimination for the bar when visibility was held constant. Detection and/or recognition of MD letters can be degraded by removal of brain tissues underlying prestriate cortex without affecting contrast sensitivity, Snellen acuity, low contrast acuity or sensitivity to motion. Shape discrimination for an MD rectangle can be as low as 2-3 percent--as good as for an LD rectangle. Evidence for a neural mechanism sensitive to shape independently of size, evidence for a neural mechanism directly sensitive to time to collision with an approaching object, a method for measuring intersubject differences in discrimination of time to contact, a titration method for uncovering the color-defined form system, and the 40 Hz human brain response indexes magnocellular activity is discussed. By recording the magnetic field of the brain we have identified an audio-visual integration area in the brain, we have also unconfounded responses to texture-defined form. GRA

N93-23960# Brown Univ., Providence, RI. Inst. for Brain and Neural Systems.
THEORY OF SYNAPTIC PLASTICITY IN VISUAL CORTEX
NATHAN INTRATOR, MARK F. BEAR, LEON N. COOPER, and MICHAEL A. PARADISO 23 Dec. 1992 23 p
(Contract N00014-91-J-1316)
(AD-A260052; TR-62) Avail: CASI HC A03/MF A01

A short account is given of the theory of synaptic plasticity: assumptions, consequences, comparison with experiment, and statistical properties. In addition a framework for comparison with other theoretical ideas is presented. GRA

N93-23986# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
WHY DO WE SEE THREE-DIMENSIONAL OBJECTS?
THOMAS MARILL Jun. 1992 32 p
(Contract N00014-85-K-0124)
(AD-A259892; AI-M-1366) Avail: CASI HC A03/MF A01

When we look at certain line-drawings, we see three-dimensional objects. The question is why. Why not just see two-dimensional images? Our theory is that we see the objects rather than the images because the objects are simpler than the images. We define the complexity of an object as the number of bits in a pose-independent, binary representation of that object. We examine a number of examples and find that in each case the seen object is indeed simpler than the given image. This leads us to our second question. Given that we are going to see a three-dimensional object when we look at a line-drawing, which three-dimensional object will we see? Our theory is that the vision system will pick the simplest object from among the infinite set of possibilities. We examine a number of examples and find that in each case the data is consistent with the theory. This work is based on the pioneering ideas of Solomonoff and Kolmogorov, and on the more recent minimum description length concepts of Rissanen. GRA

N93-24104# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany). Abt. Luft- und Raumfahrtpsychologie.

INTERNATIONAL APPLICATION OF THE DLR TEST-SYSTEM: CONTINUATION OF THE COOPERATION WITH IBERIA IN PILOT SELECTION [INTERNATIONALE ANWENDUNG DES TEST-SYSTEMS DER DLR: FORTSETZUNG DER ZUSAMMENARBEIT MIT IBERIA BEI DER AUSWAHL VON NACHWUCHSFLUGZEUGFUEHRERN]

GABRIELE OSNABRUEGGE May 1992 59 p

(ISSN 0939-2963)

(DLR-FB-92-12; ETN-93-93526) Avail: CASI HC A04/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Work to further develop a test system for the selection of student pilots is presented. Its completion by two further tests, the analysis of the personality questionnaire with regard to the intercultural comparability of its psychometric qualities, as well as the translation of the test system into Spanish language, and the results of several selection campaigns, are reported. The introduction of the two further tests, for auditory memory and for visual (short term) perception, is described. Improvements to tasks and evaluation of the simulator test which emerged during testing are reported. One group of applicants completely underwent the whole test system (those who would normally have been de-selected after paper and pencil tests were taken into the apparatus test phase) and this data analysis is given. ESA

N93-24192*# ECC International Corp., Orlando, FL. Simulations and Technology Div.

TRAINING HIGH PERFORMANCE SKILLS USING ABOVE REAL-TIME TRAINING Final Report

DUTCH GUCKENBERGER, KEVIN C. ULIANO (University of Central Florida, Orlando.), and NORMAN E. LANE (University of Central Florida, Orlando.) Jan. 1993 58 p

(Contract NAG2-750)

(NASA-CR-192616; NAS 1.26:192616) Avail: CASI HC A04/MF A01

The Above Real-Time Training (ARTT) concept is a unique approach to training high performance skills. ARTT refers to a training paradigm that places the operator in a simulated environment that functions at faster than normal time. Such a training paradigm represents a departure from the intuitive, but not often supported, feeling that the best practice is determined by the training environment with the highest fidelity. This approach is hypothesized to provide greater 'transfer value' per simulation trial, by incorporating training techniques and instructional features into the simulator. These techniques allow individuals to acquire these critical skills faster and with greater retention. ARTT also allows an individual trained in 'fast time' to operate at what appears to be a more confident state, when the same task is performed in a real-time environment. Two related experiments are discussed. The findings appear to be consistent with previous findings that show positive effects of task variation during training. Moreover, ARTT has merit in improving or maintaining transfer with sharp reductions in training time. There are indications that the effectiveness of ARTT varies as a function of task content and possibly task difficulty. Other implications for ARTT are discussed along with future research directions. Author (revised)

N93-24227# SRI International Corp., Menlo Park, CA. Artificial Intelligence Center.

INTERPRETATION AS ABDUCTION

JERRY R. HOBBS, MARK STICKEL, DOUGLAS APPELT, and PAUL MARTIN 1992 68 p

(Contract N00014-85-C-0013; N00014-90-C-0220)

(AD-A259608) Avail: CASI HC A04/MF A01

Abduction is inference to the best explanation. In the TACITUS project at SRI we have developed an approach to abductive inference, called weighted abduction, that has resulted in a significant simplification of how the problem of interpreting texts is conceptualized. The interpretation of a text is the minimal explanation of why the text would be true. More precisely, to interpret a text, one must prove the logical form of the text from what is already mutually known, allowing for coercions, merging redundancies where possible, and making assumptions where necessary. It is shown how such local pragmatics problems as reference resolution, the interpretation of compound nominals, the resolution of syntactic ambiguity and metonymy, and schema recognition can be solved in this manner. Moreover, this approach of interpretation as abduction can be combined with the older view of parsing as deduction to produce an elegant and thorough integration of syntax, semantics, and pragmatics, one that spans the range of linguistic phenomena from phonology to discourse structure. Finally, we discuss means for making the abduction process efficient, possibilities for extending the approach to other pragmatics phenomena, and the semantics of the weights and costs in the abduction scheme. GRA

N93-24297# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Physiology.

EYE MOVEMENTS AND VISUAL INFORMATION PROCESSING Annual Report, 30 Sep. 1991 - 29 Sep. 1992

EILEEN KOWLER 1992 4 p

(Contract AF-AFOSR-0342-91)

(AD-A259955; AFOSR-93-0024TR) Avail: CASI HC A01/MF A01

The central goal of the project funded by the current grant is the understanding of how saccadic eye movements are used to accurately localize objects in space. Explaining accurate localization is a real problem because the objects we choose to look at are relatively large -- typically extending over several degrees of space -- but the saccadic eye movement must land at one place within the target. Our published research suggests that the computation requires a sequence of two stages: (1) voluntary attentional weighting of information in the visual display, and (2) automatic-spatial-pooling of the weighted formation (He and Kowler, 1989; 1991). GRA

N93-24319# Naval Aerospace Medical Research Lab., Pensacola, FL.

THE FIVE-FACTOR PERSONALITY MODEL AND NAVAL AVIATION CANDIDATES

KATHLEEN T. HELTON and DAVID R. STREET, JR. Nov. 1992 16 p

(Contract DA PROJ. M00-96; DA PROJ. M00-96)

(AD-A260227; NAMRL-1379) Avail: CASI HC A03/MF A01

As personality testing has improved, various models for constructing and interpreting aviation selection tests have been proposed. Of particular interest to our study is the use of the five-factor personality model to naval aviation selection test interpretation and development. The five personality factors are conscientiousness, agreeableness, openness, extraversion, and neuroticism. Therefore, we conducted a joint factor analysis on the Pilot Personality Questionnaire (PPQ) and the Edwards Personal Preference Schedule (EPPS) taken by 158 Navy and Marine Corps student aviators. A principal component analysis (PCA) and a factor analysis (FA) with varimax rotations produced a robust five-factor solution. On the basis of content analysis, the FA factors obtained in our study coincided with the five classic dimensions of the five-factor personality model. Although investigations of personality in pilot selection have yielded mixed results, the finding of a five-factor solution in our study suggests that the five-factor personality model may be useful in personality testing in aviation selection decisions. GRA

N93-24345# European Space Agency, Cologne (Germany). Astronauts Div.

SELECTION OF ASTRONAUTS FOR EUROPEAN SPACE MISSIONS

F. ROSSITTO and H. SCHAARSCHMIDT *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 51-53 Jul. 1992

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

A detailed overview of the organizational aspects and activities performed during the selection of the European astronaut

candidates is presented. Sixty applications were presented to ESA. The selection phase was divided into two phases: the first phase was dedicated to the psychological assessment and to the professional evaluation; and the second phase was dedicated to the general medical evaluation and to the space specific medical evaluation. ESA

N93-24346# European Space Agency, Cologne (Germany). European Astronauts Div.
THE EUROPEAN ASTRONAUTS TRAINING PROGRAMME
K. DAMIAN, O. CHIARENZA, H. AREND, and P. NESPOLI *In its* Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 55-61 Jul. 1992
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

An overview of the overall training program for European astronauts--who include laboratory specialists and spaceplane specialists-- is given. The laboratory specialists are primarily specialized in the servicing and operation of the Columbus Free Flying Laboratory as well as the Columbus Attached Laboratory and of the other elements of the Space Station Fredom manned base. The Spaceplane specialists are primarily concerned with the operations of the European spaceplane Hermes. The training program covers basic training, specialized training, mission training, and proficiency maintenance. The structure and major contents of the training phases are explained. Basic training provides basic knowledge of space technology and science and basic skills related to future operational tasks. Specialized training provides knowledge and skills related to specific space elements and specific types of missions. Mission training provides the knowledge and skills required to perform a specific mission/increment. An overview of the training facilities which will be used during the training program is also given. ESA

N93-24352# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Crew Operations Dept.
MIR 1992 OPERATIONS AND CREW TRAINING
BOLENDER, R. EWALD, K.-D. FLADE, S. JAEHN, R. LENTZEN, A. PUTZKA, A. SCHOEN, H. STEIMLE, H. STROMEYER, and W. WYBORNY *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 87-89 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Preparations and implementation of crew operations and training for the visit of the German science astronaut to the Mir Space Station in Mar. 1992 are highlighted. Apart from the basic training, cosmonaut candidates underwent specialized cosmonaut and science training. A total of 14 experiment objectives with a set of complex experiment equipment were developed by experimenters and German industry, respectively. Experiment processing, equipment, and Mir generic requirements were integrated into training and payload procedures and Mir Space Station resource requirements. ESA

N93-24366# Technische Univ., Vienna (Austria). Universitaetsklinik fuer Neurologie.
OPTOVERT: AN AUSTROMIR-1991 EXPERIMENT. ORIENTATIONAL EFFECTS FROM OPTOKINETIC STIMULATION
C. MUELLER, L. KORNILOVA (Institute of Biomedical Problems, Moscow, USSR.), G. WIEST, and L. DEECKE *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 163-167 Jul. 1992
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The Optovert experiment carried out on the third and fifth day of the Austromir 91 space flight is described. The main aim of the experiment was to explore in microgravity the vertical vection illusion which was elicited by means of an optokinetic stimulator system. The cosmonaut was instructed to fixate a central light emitting diode on a spherical screen (60 deg of visual angle in diameter) during up and down motion of a dot pattern. In addition optokinetically induced eye movements were examined as well as the ability for setting the visual vertical correctly. A slight preponderance for downward vection and the occurrence of inverted vection with extreme phase shift during sinusoidal stimulation were considered to be the most striking orientational phenomena in flight. ESA

N93-24382# Danish Aerospace Medical Center of Research, Copenhagen.
TRAINING CONCEPT FOR CREW, END USER, AND GROUND CENTRE PERSONNEL IN THE COLUMBUS UTILISATION PROGRAMME
T. A. E. ANDERSEN, H. T. BLUME (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. P. A. M. BROUWER (National Aerospace Lab., Emmeloord, Netherlands.), L. DANGELO (Microgravity Advanced Research and Support Center, Naples, Italy.), H. DUWE (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), N. EILERSEN, M. GAIDA (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), M. HERTEN (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.), T.-H. IVERSEN, C. JUNGIUS (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany.) et al. *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 257-262 Jul. 1992
Copyright Avail: CASI HC A02/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Training concepts developed by the European User Support Organisation (USO) definition team for crew, experimenters and for the user support personnel of the Utilisation Centers (UC), are addressed. The concept concentrates on experiment operation for the Attached Laboratory and the Free Flying Laboratory. Implementation of the training concept will depend on the trainees: laboratory specialists, new or experienced users and technical or administrative UC personel. The concepts, however, are based on the same fundamental principles: the training and lessons will be given directly by personnel who have expert knowledge and responsibility during the increment operation. The concept will not only minimize the educational period, but the complexity of the training will be restricted to the real knowledge required by the trainees. The organization of the training will also minimize the number and duration of travels. ESA

N93-24431# Army Aeromedical Research Lab., Fort Rucker, AL.
HUMAN VISUAL LIMITATIONS ON SUPRATHRESHOLD CONTRAST PERCEPTION THROUGH ANVIS Final Report
JEFF C. RABIN Dec. 1992 24 p
(Contract DA PROJ. 3M1-62787-A-879)
(AD-A259970; USAARL-93-3) Avail: CASI HC A03/MF A01

Recent success on the battlefield underscored the tactical advantage of night operations and image intensifying devices. It is important to understand both the benefits and limitations inherent in these devices. While several studies have focused on spatial resolution thresholds through image intensifiers, less is known about visual perception at suprathreshold levels of stimulation. Such information is necessary to anticipate and predict visual performance under various conditions. In this study contrast matching was used to evaluate suprathreshold visual perception under conditions which simulated the luminance, contrast, and chromaticity of third generation image intensifiers contained in the Aviator's Night Vision Imaging System (ANVIS). The apparent contrast of letters in this simulated ANVIS environment was reduced by a factor of two when compared to normal photopic levels of stimulation. This effect was attributed to limitations of the human visual system in processing higher spatial frequencies at low light levels. Theme results help to quantify and discriminate between visual and electro-optical limitations on vision through image intensifiers. GRA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A93-30051
HELMET-MOUNTED DISPLAYS III; PROCEEDINGS OF THE MEETING, ORLANDO, FL, APR. 21, 22, 1992
THOMAS M. LIPPERT, ED. (Honeywell, Inc., Minneapolis, MN) Bellingham, WA Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 1695) 1992 187 p.
(SPIE-1695; ISBN 0-8194-0860-3) Copyright

The present conference on helmet-mounted display (HMD) systems discusses topics concerning their development and testing, their use in training and simulation, and HMD image quality and human-interface factors. Attention is given to HMDs for USAF/USN fixed-wing aircraft night vision, the role of HMDs in combat aircraft cockpits, HMDs for night-attack missions, low-cost monochrome CRTs for HMDs, and a low-cost HMD color display. Also discussed are intensified CCD sensor applications for HMDs, miniature projection CRTs for HMDs, the anthropometry of HMD design, predictive nosepointing and flight-path displays for air-to-air combat, and a comparison of CRT display-measurement techniques. (For individual items see A93-30052 to A93-30072) O.C.

A93-30052
HELMET-MOUNTED SYSTEMS TECHNOLOGY PLANNING FOR THE FUTURE
PRESTON S. HALL (USAF, Armstrong Lab., Wright-Patterson AFB, OH) and BRUCE L. CAMPBELL (Ball Corp., Ball Systems Engineering Div., Fairborn, OH) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 2-7.
Copyright

Helmet-mounted display (HMD) technologies are undergoing integration in a USAF Armstrong Laboratory program which aims at the dramatic enhancement of pilot situational awareness under all operational conditions, while improving weapon system effectiveness. A systems engineering approach is used throughout these HMD technology-integration efforts, which encompass 3D audio, high voltage and fiber-optic quick-disconnect connector, high-resolution video displays and targeting sights, and standardized symbology. O.C.

A93-30053
HELMET-MOUNTED SYSTEMS TEST AND EVALUATION PROCESS
CHRISTIAN P. BENEDICT (USAF, Armstrong Lab., Wright-Patterson AFB, OH) and RONALD G. GUNDERMAN (Ball Corp., Ball Systems Engineering Div., Fairborn, OH) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 8-12. refs
Copyright

An account is given of the test and evaluation process developed by the USAF Armstrong Laboratory for Helmet-Mounted Systems Technology (HMST). The HMST test process is a direct development of Interim Night Integrated Goggle and Head Tracking System experience. Attention is given by the process to the type of aircraft in question, the use of ejection seats, the position of the crew seat in the cockpit in question, and the flight profile with which the equipment will typically be used. O.C.

A93-30054
I-NIGHTS AND BEYOND
JAMES A. STIFFLER (Ball Corp., Ball Systems Engineering Div., Fairborn, OH) and LARRY WILEY (USAF, Armstrong Lab., Wright-Patterson AFB, OH) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 13-20. refs
Copyright

The USAF's Interim-Night Integrated Goggle and Head Tracking System (I-NIGHTS) identified many of the challenges associated with head-mounted display (HMD) design. Attention is presently given to the pertinence of I-NIGHTS experience to such factors as HMD 'fit', weight/center of gravity, and compatibility with crewmember ejection. Ejection involved questions concerning windblast head/neck loads and the design of a quick-disconnect high-voltage live to the HMD. O.C.

A93-30055
USAF/USN FIXED WING NIGHT VISION - THE MISSION
CHUCK ANTONIO (Dayton Univ.; USAF, Human Resources Directorate, Williams AFB, AZ) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 21-25.
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The present discussion of prospective combat night-vision devises (NVDs) encompasses night-vision goggles (NVGs) and forward-looking IR (FLIR) devices. Attention is given to the role of NVDs in tactics, threat avoidance, and navigation, as well as the consequentiality of their resolution vs field-of-view characteristics, unaided NVG and FLIR field-of-view, NVG center of gravity, head-mounting considerations, and off-boresight capability. O.C.

A93-30056
THE ADVENT OF HELMET-MOUNTED DEVICES IN THE COMBAT AIRCRAFT COCKPIT - AN OPERATOR'S VIEWPOINT
F. W. CHAPMAN (RAF, United Kingdom) and G. J. N. CLARKSON (Defence Research Agency, Flight Systems Dept., Farnborough, United Kingdom) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 26-37. refs
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The UK's Defense Research Agency has undertaken the development of such helmet-mounted display devices as helmet-mounted sights (HMSs), with a view to their integration into combat aircraft cockpits. Attention is presently given to test trial results for two HMSs which foreshadow prospective parallel developments in combat aircraft cockpits and their simulation equipment. It is noted that, increasingly, pilot capabilities are becoming the most fundamental limiting factor. O.C.

A93-30057
HELMET MOUNTED DISPLAY WITH MULTIPLE IMAGE SOURCES
GEORGE C. BULL (GEC Avionics, Ltd., Rochester, United Kingdom) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 38-46.
Copyright

A helmet-mounted display (HMD) allows a pilot to choose between the imagery generated by forward-looking IR (FLIR) sensors and night-vision goggles; the pilot can select the sensor and its operating mode to maintain images in such conditions as high humidity, thermal gradients, and total darkness. An account is presently given of the design of a new HMD for both fixed-wing and rotorcraft applications which uses a binocular image intensifier display for low perceived noise as well as a binocular CRT display for FLIR displays without binocular rivalry. O.C.

A93-30058
COLOR HELMET DISPLAY FOR THE TACTICAL ENVIRONMENT - THE PILOT'S CHROMATIC PERSPECTIVE
JAMES E. MELZER and KIRK W. MOFFITT (Kaiser Electronics, San Jose, CA) *In* Helmet-mounted displays III; Proceedings of

the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 47-51. refs
Copyright

While the use of color by helmet-mounted displays (HMDs) promise pilot workload reductions and performance enhancements, three widely acknowledged paradigms preclude the use of color in aviation HMDs. Attention is presently given to three corresponding paradigm shifts that will encourage the introduction of color symbology, graphics and imagery to HMD designs. The rationales for the paradigm shifts involve novel methods of training and rehearsing, new lighting environments, and such innovative display technologies as liquid crystal shutter image sources. O.C.

A93-30059
HELMET-MOUNTED DISPLAY FOR THE NIGHT ATTACK MISSION
ROBERT J. WHITCRAFT (Honeywell, Inc., Saint Louis Park, MN) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 52-56.
Copyright

A CRT-based helmet-mounted display (HMD) that is coupled with a head-steered forward-looking IR system is presently shown to furnish significant operational advantages over goggle systems currently in use in the presentation of navigation and targeting information. Unlike a goggle system, the HMD minimizes the risk of neck and head injury in the event of ejection. Attention is given to an attack/reconnaissance/close support fighter aircraft HMD. O.C.

A93-30060
HELMET-MOUNTED AREA OF INTEREST
GEORGE KELLY (Dayton Univ., Williams AFB, AZ), MARTIN SHENKER, and PAUL WEISSMAN (Martin Shenker Optical Design, Inc., White Plains, NY) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 58-63. Research supported by USAF refs
Copyright

A novel simulator display system is described. The display consists of a full field of view rear screen projection display and a narrow field of view high resolution helmet-mounted display (HMD). The HMD is worn by the pilot within the projection display. The virtual image of the HMD is thus superimposed upon the real image of the projection display. This hybrid approach to building a wide field of view display takes advantage of the beneficial aspects of both projection displays and HMDs. The result is a low cost total field of view display with high resolution. Several system design problems arise in the integration of the HMD with the projection display. These issues are discussed, and include: the design of an HMD eyepiece with minimal obtrusiveness, visual blending of the HMD imagery with the projected imagery, and timing and perspective issues relating to the computer generated imagery presented by both the HMD and the projection display. Author

A93-30061
LOW-COST MONOCHROME CRT HELMET DISPLAY
ROGER W. LEINENWEVER, LEONARD G. BEST, and BRYCE J. ERICKSEN (GE Government Services, Williams AFB, AZ) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 64-67. Research sponsored by USAF
Copyright

The present head-mounted display (HMD) development involves the use of a low-cost monochrome CRT display in a way that incorporates see-through optics and allows the integration of various image-generation systems for low cost cockpit trainers and night-vision goggle training applications. A major goal for this HMD design was the furnishing of a full field-of-regard, using a head-tracket system. The HMD system devised incorporates two 1-inch CRTs with beam-splitters and spherical mirrors. O.C.

A93-30062
LOW-COST COLOR LCD HELMET DISPLAY
ROGER W. LEINENWEVER, LEONARD G. BEST, and BRYCE J. ERICKSEN (GE Government Services, Williams AFB, AZ) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 68-71. Research sponsored by USAF
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The present head-mounted display (HMD) development effort has attempted to demonstrate the feasibility and capabilities of a low-cost color display that incorporates see-through optics and a head-tracking system for full field-of-regard. The color-imaging devices are 3-inch diagonal LCD panels; fiber-optic light panels mounted behind the LCDs furnish a cool light source. A beam-splitting function is incorporated into the optics to allow cockpit-instrument viewing while revealing the out-of-window scene. O.C.

A93-30063
THE REALITIES OF USING VISUALLY COUPLED SYSTEMS FOR TRAINING APPLICATIONS
ROY S. KALAWSKY (British Aerospace, PLC, Brough, United Kingdom) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 72-82. refs
Copyright

A full understanding of the shortcomings as well as advantages of virtual reality (VR) technologies will allow their application in training applications. Attention is presently given to the insufficiency of human factors-related understanding in the design of such 'visually coupled' systems to date. VR training environments entail extreme attention to requirement/simulation matching and optimization. O.C.

A93-30064
INTENSIFIED CCD SENSOR APPLICATIONS FOR HELMET-MOUNTED DISPLAYS
LAWRENCE H. GILLIGAN (Electro-Optical Services, Inc., Charlottesville, VA) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 83-90.
Copyright

State-of-the-art intensified CCD (ICCD) sensors are candidates for use in head-mounted displays (HMDs), as indicated by the present review of their parametric characteristics and prospective-capabilities trends. Attention is given to ICCD resolution, sensitivity and spectrum, as well as their consequent color imagery and depth perception characteristics in HMD aplications. A major prospective improvement is the incorporation of range-gating for obscurant penetration. O.C.

A93-30065
QUICK-DISCONNECT HARNESS SYSTEM FOR HELMET-MOUNTED DISPLAYS
P. T. BAPU, J. M. AULDS, S. P. FUCHS (Dayton Univ., OH), and DAVE MCCORMICK (Reynolds Industries, Inc., Los Angeles, CA) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 91-99. refs (Contract F33615-89-C-0532)
Copyright

We have designed a pilot's harness-mounted, high voltage quick-disconnect connector with 62 pins, to transmit voltages up to 13.5 kV and video signals with 70 MHz bandwidth, for a binocular helmet-mounted display system. It connects and disconnects with power off, and disconnects 'hot' without pilot intervention and

without producing external sparks or exposing hot embers to the explosive cockpit environment. We have implemented a procedure in which the high voltage pins disconnect inside a hermetically-sealed unit before the physical separation of the connector. The 'hot' separation triggers a crowbar circuit in the high voltage power supplies for additional protection. Conductor locations and shields are designed to reduce capacitance in the circuit and avoid crosstalk among adjacent circuits. The quick-disconnect connector and wiring harness are human-engineered to ensure pilot safety and mobility. The connector backshell is equipped with two hybrid video amplifiers to improve the clarity of the video signals. Shielded wires and coaxial cables are molded as a multi-layered ribbon for maximum flexibility between the pilot's harness and helmet. Stiff cabling is provided between the quick-disconnect connector and the aircraft console to control behavior during seat ejection. The components of the system have been successfully tested for safety, performance, ergonomic considerations, and reliability. Author

A93-30066
ADVANCES IN MINIATURE PROJECTION CRTS FOR HELMET DISPLAYS
J. P. SAUERBORN (Hughes Display Products Corp., Lexington, KY) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 102-116. refs
Copyright

Prospective advancements in CRT electron optics design practices, packaging, and phosphor screens promise to take CRT image sources for helmet-mounted displays (HMDs) to much higher levels of performance. Attention is presently drawn to problematic areas in these developments, such as the durability of the phosphor screen and cathode and the Coulombic degradation of the screen. Immediate incorporation of color displays in HMDs could proceed through the use of a liquid crystal shutter, or of penetration phosphors. O.C.

A93-30067
COMPARISON OF CRT DISPLAY MEASUREMENT TECHNIQUES
ROBERT W. VERONA (UES, Inc., Fort Rucker, AL) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 117-127. refs
(Contract DAMD17-91-C-1081)
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Several subjective and objective CRT performance-evaluation techniques are discussed for the case of a miniature CRT for use in helmet-mounted displays. It was stipulated that the performance-measurement technique should be implementable with commercially available hardware, and that performance results should be arrived at quickly and accurately. The subjective methods were those of 'shrinking raster' and 'line width' measurement; the objective methods involved half-power width and the Fourier transform. O.C.

A93-30068
QUANTITATIVE HELMET MOUNTED DISPLAY SYSTEM IMAGE QUALITY MODEL
SCOTT A. NELSON and J. A. COX (Honeywell Systems and Research Center, Bloomington, MN) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 128-137. refs
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A quantitative image quality model for Helmet Mounted Display (HMD) electrooptical systems has been developed that will predict the optical performance and image quality of a given system configuration. The linear systems model includes modules for the image intensifier objective, image intensifier tube, fiber optic faceplates and tapers, CCD camera, LCD or CRT image source, relay optics, electronic filtering and preprocessing, and a perception model for the eye. Sine wave and square wave system response are predicted via modulation transform function calculations as well as the maximum resolution and a measurement of just noticeable differences as perceived by the human eye. The model will allow the system designer to quickly and inexpensively evaluate complex systems tradeoffs and modifications to advanced HMD systems. Author

A93-30069
ANTHROPOMETRY FOR HMD DESIGN
KATHLEEN M. ROBINETTE (USAF, Armstrong Lab., Wright-Patterson AFB, OH) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 138-145. Research supported by USAF refs
Copyright

An account is given of the helmet-retention and optical and acoustical performance consequences of helmet-mounted display (HMD) designs' anthropometric fitting. Advanced HMDs require more refined anthropometric practices, concerned with careful definition of surface curvature changes. Novel approaches in head measurement are compared with conventional ones that have proved to be problematic. O.C.

A93-30070* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EVALUATION OF CONFORMAL AND BODY-AXIS ATTITUDE INFORMATION FOR SPATIAL AWARENESS
DENISE R. JONES, TERENCE S. ABBOTT, and JAMES R. BURLEY, II (NASA, Langley Research Center, Hampton, VA) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 146-153. refs
Copyright

The traditional head-up display (HUD) used in most modern fighter aircraft presents attitude information that is both conformal to the outside world and aligned with the body-axis of the aircraft. The introduction of helmet-mounted display (HMD) technology into simulated and actual flight environments has introduced an interesting issue regarding the presentation of attitude information. This information can be presented conformally or relative to the aircraft's body-axis, but not both (except in the special case where the pilot's line of sight is directly matched with the aircraft's body-axis). The question addressed with this study was whether attitude information displayed in an HMD should be presented with respect to the real world (conformally) or to the aircraft's body-axis. To answer this, both conformal and body-axis attitude symbology were compared under simulated air combat situations. The results of this study indicated that the body-axis concept was a more effective HMD display. A detailed description of the flight task and results of this study will be presented. Author

A93-30071* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PREDICTIVE NOSEPOINTING AND FLIGHTPATH DISPLAYS FOR AIR-TO-AIR COMBAT
SALLY A. VIKEN (Lockheed Engineering & Sciences Co., Hampton, VA) and JAMES R. BURLEY, II (NASA, Langley Research Center, Hampton, VA) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 154-165. refs
Copyright

As part of the High-Angle-of-Attack Technology Program (HATP), two integrated pictorial displays have been developed for piloted simulation evaluations and, ultimately, for flight testing on board the F/A-18 High Alpha Research Vehicle (HARV). The first concept is a nosepointing display which illustrates the range of control the pilot has over the aircraft nose. The second concept is a predictive flightpath display that allows the pilot to see how his current control inputs will affect his aircraft's future position and orientation. The development of both display concepts will be

discussed, as well as the results from a piloted simulation experiment in which pilots viewed the flightpath display in a wide-field-of-view Helmet-Mounted Display (HMD) while engaged in an air-combat situation. Author

A93-30072
VISUAL ILLUSIONS AND OTHER EFFECTS WITH NIGHT VISION DEVICES
JOHN S. CROWLEY, CLARENCE E. RASH, and ROBERT L. STEPHENS (U.S. Army, Aeromedical Research Lab., Fort Rucker, AL) *In* Helmet-mounted displays III; Proceedings of the Meeting, Orlando, FL, Apr. 21, 22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 166-180. refs
Copyright

To investigate the breadth of visual illusions experienced by aviators flying with night vision devices (NVDs), an open-ended questionnaire was distributed to the military helicopter community. Of the 242 returned questionnaires, there were 221 image intensification (I 2) reports and 21 thermal imaging system reports. Most sensory events occurred at night, during low illumination, good weather, and over varied terrain. Contributing factors included inexperience, division of attention, and fatigue. Frequently reported illusions were misjudgments of drift, clearance, height above the terrain, and attitude. Also reported were illusions due to external lights and disturbed depth perception caused by differences in brightness between I 2 tubes. Other respondents cited hardware problems and physiological effects. There were no obvious differences between the experiences of I 2 users and FLIR (forward-looking infrared) users. Author

A93-30287
THE EFFECT OF WEARING PROTECTIVE CHEMICAL WARFARE COMBAT CLOTHING ON HUMAN PERFORMANCE
HENRY L. TAYLOR (Illinois Univ., Urbana) and JESSE ORLANSKY (Inst. for Defense Analyses, Alexandria, VA) Aviation, Space, and Environmental Medicine Supplement (ISSN 0095-6562) vol. 64, no. 3 March 1993 p. A1-A41. refs
(Contract MDA903-89-C-0003)
Copyright

DOD studies of performance decrements due to heat stress associated with chemical warfare-protective combat clothing show serious performance deteriorations; degraded performance occurs even when heat stress is not a factor. Training in chemical warfare-protective combat clothing facilitates the determination of procedure-modification for negative effect minimization, provided that heat stress does not become a significant factor. Attention is drawn to evidence for the inadequacy of chemical warfare training. O.C.

A93-30439
DYNAMIC MULTIOBJECTIVE DECISION AND ITS APPLICATION IN ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM
JIN-DUN CHEN (Inst. of Space Medico-Engineering, Beijing, China) et al. Space Medicine & Medical Engineering (ISSN 1002-0837) vol. 5, no. 4 1992 p. 263-270. In Chinese. refs

The paper develops an approach to improve the hierarchical resolving method of multiobjective dynamic programming. The hierarchical and staged resolving of the dynamic multiobjective decision is presented. The method converted the multiobjective decision into a series of single objective decisions according to importance. The suitable policy sets of each goal is determined by the method of stage searching and sifting in each level. The optimum option is recommended. The method's advantage is that the quantity of computation decreases from layer to layer and from stage to stage, especially for complicated systems. A practical example illustrating the method's capability to assess and optimize technological projects for the resolution of the metabolic oxygen recovery process is presented. P.D.

A93-30454* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPATIBILITY AND CONSISTENCY IN DISPLAY-CONTROL SYSTEMS - IMPLICATIONS FOR AIRCRAFT DECISION AID DESIGN
ANTHONY D. ANDRE and CHRISTOPHER D. WICKENS (Illinois Univ., Urbana) Human Factors (ISSN 0018-7208) vol. 34, no. 6 Dec. 1992 p. 639-653. refs
(Contract NCC2-632)
Copyright

In this study we contrast display-control movement relations defined in terms of stimulus-response (physical) compatibility with those defined by stimulus-cognitive compatibility, and we relate these findings to the issue of command versus status levels of decision aid support. A second issue addressed is the cost of inconsistency across multiple display-control mappings. Subjects performed a flight control task while responding to one to four analog indicators, formatted as either command or status displays. The results suggest that there is an advantage for the status format when subjects are required to verbally report the state of the indicator(s), but no advantage was found for either format when subjects were required to manually correct the indicated state. The data point to the importance of display-control consistency and suggest that it may even outweigh that of compatibility. Author

A93-30455
FACTORS THAT AFFECT DEPTH PERCEPTION IN STEREOSCOPIC DISPLAYS
ROBERT PATTERSON (Washington State Univ., Pullman), LINDA MOE, and TIGER HEWITT (Montana State Univ., Bozeman) Human Factors (ISSN 0018-7208) vol. 34, no. 6 Dec. 1992 p. 655-667. refs
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This study investigated several factors that affect depth perception in stereoscopic displays: half-image separation magnitude, separation direction (crossed vs. uncrossed), viewing distance, stimulus size, and exposure duration. The depth perceived under various combinations of levels of these factors was compared with depth predicted by the geometry of stereopsis. Perceived depth in the crossed-separation direction was frequently close to predictions, such that increases in separation and viewing distance produced appropriate increases in perceived depth. Depth in the uncrossed direction was frequently less than that predicted, especially for small stimuli presented at a long viewing distance, with a large half-image separation, and/or with a brief duration. Thus depth in both crossed and uncrossed directions equaled predictions only for large stimuli exposed for a long duration. Author

A93-31031#
ROBOTICS EVALUATION AND CHARACTERIZATION (REACH) OF THE SSRMS CONCEPT AND TECHNICAL ISSUES
W. B. GRAHAM, R. K. SINGHAL, S. KALAYCIOGLU (Canadian Space Agency, Ottawa, Canada), and A. FAHIM (Ottawa Univ., Canada) Feb. 1993 12 p. AIAA, AHS, and ASEE, Aerospace Design Conference, Irvine, CA, Feb. 16-19, 1993 refs
(AIAA PAPER 93-1156) Copyright

The Space Station Remote Manipulator System (SSRMS) is a major element of Canada's contribution to the Space Station Freedom (SSF). The SSRMS will undergo verification tests and subsequently will become fully functional after delivery to orbit of the Mobile Base System (MBS) on which the SSRMS will normally operate. Characterization or testing of terrestrial robots is a relatively recent technology. Generally, characterization is aimed at measuring key parameters (e.g. accuracy, repeatability, stopping distance etc. throughout the work volume) which are paramount for safe and efficient operation of the system. The characterization process requires significant measurement capability. The goal of the REACH project is to evaluate and characterize the SSRMS in-orbit as a robotics system. This paper outlines the current state-of-the-art of characterizing terrestrial robots. The paper also

presents the preliminary concepts and techniques that are being developed to characterize the SSRMS. Author

A93-31032#
FLIGHT TELEROBOTIC SERVICER LEGACY
PAUL L. SHATTUCK and JAMES W. LOWRIE (Martin Marietta Astronautics Group, Denver, CO) Feb. 1993 16 p. AIAA, AHS, and ASEE, Aerospace Design Conference, Irvine, CA, Feb. 16-19, 1993 Previously cited in issue 10, p. 1825, Accession no. A93-29106
(AIAA PAPER 93-1157) Copyright

A93-31034*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN OPERATOR INTERFACE DESIGN FOR A TELEROBOTIC INSPECTION SYSTEM
WON S. KIM, KAM S. TSO, and SAMAD HAYATI (JPL, Pasadena, CA) Feb. 1993 11 p. AIAA, AHS, and ASEE, Aerospace Design Conference, Irvine, CA, Feb. 16-19, 1993 refs
(AIAA PAPER 93-1160) Copyright

The operator interface has recently emerged as an important element for efficient and safe interactions between human operators and telerobotics. Advances in graphical user interface and graphics technologies enable us to produce very efficient operator interface designs. This paper describes an efficient graphical operator interface design newly developed for remote surface inspection at NASA-JPL. The interface, designed so that remote surface inspection can be performed by a single operator with an integrated robot control and image inspection capability, supports three inspection strategies of teleoperated human visual inspection, human visual inspection with automated scanning, and machine-vision-based automated inspection. Author

A93-31517 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CENTRALIZED, DECENTRALIZED, AND INDEPENDENT CONTROL OF A FLEXIBLE MANIPULATOR ON A FLEXIBLE BASE
FEIYUE LI, PETER M. BAINUM, and JIANKE XU (Howard Univ., Washington) Acta Astronautica (ISSN 0094-5765) vol. 29, no. 3 March 1993 p. 159-168. Previously cited in issue 03, p. 439, Accession no. A92-15260 refs
(Contract NSG-1414; NAGW-2950)
Copyright

A93-31522
EMATS, A ROBOT-BASED EQUIPMENT MANIPULATION AND TRANSPORTATION SYSTEM FOR THE COLUMBUS FREE FLYING LABORATORY
P. PUTZ (Dornier GmbH, Friedrichshafen, Germany), G. COLOMBINA (Tecnospazio S.p.A., Milan, Italy), and W. DE PEUTER (ESTEC, Noordwijk, Netherlands) Acta Astronautica (ISSN 0094-5765) vol. 29, no. 3 March 1993 p. 205-211. Previously cited in issue 03, p. 402, Accession no. A91-13746 refs
Copyright

A93-31533
ON THE CONTROL OF A CLASS OF FLEXIBLE MANIPULATORS USING FEEDBACK LINEARIZATION APPROACH
V. J. MODI, F. KARRAY, and J. K. CHAN (British Columbia Univ., Vancouver, Canada) Acta Astronautica (ISSN 0094-5765) vol. 29, no. 1 Jan. 1993 p. 17-27. Previously cited in issue 03, p. 439, Accession no. A92-14737 Research supported by Centers of Excellence Program refs
(Contract NSERC-A-2181)
Copyright

A93-31626
LOOKS CAN KILL
GRAHAM WARWICK, SIMON ELLIOTT, ARI EGOZI, and GILBERT SEDBON Flight International (ISSN 0015-3710) vol. 143, no. 4355 Feb. 3, 1993 p. 33-36.
Copyright

A development status and performance characteristics evaluation is presented for helmet-mounted displays (HMDs), which furnish military aircraft crews all-aspect navigation and targeting capabilities. While the USAF's F-15-based integrated Controls and Avionics for Air Superiority system will feature an HMD, NASA-Langley intends to incorporate a wide-angle, full-color HMD on its F-18 High Angle-of-Attack Research Vehicle. This NASA HMD will display 3D graphics. HMDs will also incorporate pilot vision protection against laser light. O.C.

A93-31782
COMPENSATING LAGS IN HEAD-COUPLED DISPLAYS USING HEAD POSITION PREDICTION AND IMAGE DEFLECTION
RICHARD H. Y. SO and MICHAEL J. GRIFFIN (Southampton Univ., United Kingdom) Journal of Aircraft (ISSN 0021-8669) vol. 29, no. 6 Nov.-Dec. 1992 p. 1064-1068. AIAA Flight Simulation Technologies Conference, New Orleans, LA, Aug. 12-14, 1991, Technical Papers, p. 124-130. Previously cited in issue 20, p. 3499, Accession no. A91-47814 Research supported by USAF refs
Copyright

A93-31944
MILITARY AIRCREW HEAD SUPPORT SYSTEM
R. S. DEAKIN (British Aerospace /Military Aircraft/, Ltd., Godalming, United Kingdom) Journal of Aircraft (ISSN 0021-8669) vol. 30, no. 1 Jan.-Feb. 1993 p. 100-104. ICAS, Congress, 17th, Stockholm, Sweden, Sept. 9-14, 1990, Proceedings. Vol. 1, p. 162-167. Previously cited in issue 09, p. 1447, Accession no. A91-24322 refs
Copyright

A93-31993* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ACTIVE VIBRATION DAMPING OF THE SPACE SHUTTLE REMOTE MANIPULATOR SYSTEM
MICHAEL A. SCOTT, MICHAEL G. GILBERT (NASA, Langley Research Center, Hampton, VA), and MARTHA E. DEMEO (Charles Stark Draper Lab., Inc., Cambridge, MA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090) vol. 16, no. 2 Mar.-Apr. 1993 p. 275-280. AIAA Guidance, Navigation, and Control Conference, New Orleans, LA, Aug. 12-14, 1991, Technical Papers. Vol. 1, p. 194-204. Previously cited in issue 21, p. 3719, Accession no. A91-49597 refs
Copyright

A93-32073
BIOREGENERATIVE LIFE SUPPORT AS SELF-SUSTAINING ECOSYSTEM IN SPACE
A. HAQUE (DLR, Inst. fuer Flugmedizin, Cologne, Germany) and K. KREUZBERG (Bonn Univ., Germany) Microgravity - Science and Technology (ISSN 0938-0108) vol. 6, no. 1 March 1993 p. 43-54. Research supported by DARA and Ministerium fuer Wissenschaft und Forschung refs
Copyright

While it is not yet clear to what degree bioregenerative subsystems will be accommodated aboard Space Station Freedom, such systems can be expected to evolve during the Station's service life; this may lead to an integrated ecosystem with further simplification and a greater degree of closure. An account is presently given of the biological and physicochemical life-support systems that are under investigation aboard the Mir space station. AIAA

A93-32444* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HUMAN LOW VISION IMAGE WARPING - CHANNEL MATCHING CONSIDERATIONS
RICHARD D. JUDAY (NASA, Johnson Space Center, Houston, TX), ALAN T. SMITH (Lockheed Engineering & Sciences Co., Houston, TX), and DAVID S. LOSHIN (Houston Univ., TX) *In* Visual information processing; Proceedings of the Meeting, Orlando,

FL, Apr. 20-22, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 304-313. refs
Copyright

We are investigating the possibility that a video image may productively be warped prior to presentation to a low vision patient. This could form part of a prosthesis for certain field defects. We have done preliminary quantitative studies on some notions that may be valid in calculating the image warpings. We hope the results will help make best use of time to be spent with human subjects, by guiding the selection of parameters and their range to be investigated. We liken a warping optimization to opening the largest number of spatial channels between the pixels of an input imager and resolution cells in the visual system. Some important effects are not quantified that will require human evaluation, such as local 'squashing' of the image, taken as the ratio of eigenvalues of the Jacobian of the transformation. The results indicate that the method shows quantitative promise. These results have identified some geometric transformations to evaluate further with human subjects. Author

A93-33250
TEMPORAL FREQUENCY SPECTRUM FOR DESCRIBING AND MODELING MOTION PERCEPTION
WILLIAM P. MARSHAK (USAF, Armstrong Lab., Wright-Patterson AFB, OH) *In* Automatic object recognition II; Proceedings of the Meeting, Orlando, FL, Apr. 22-24, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 476-480. Research supported by USAF refs
Copyright

The Temporal Frequency Spectrum (TFS) model for motion perception employs a transformation process analogous to those of spatial vision-related Fourier processes, and may be used both as a metric for the description of complex moving scenes and as a model for human motion perception (the model can accomplish motion perception even when the viewer is in motion). Attention is given to human psychophysical evidence for the usefulness of the TFS mechanism; the use of a TFS mechanism in machine vision is also considered. AIAA

A93-33443* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STUDIES OF THE FIELD-OF-VIEW RESOLUTION TRADEOFF IN VIRTUAL-REALITY SYSTEMS
THOMAS P. PIANTANIDA, DUANE BOMAN (SRI International, Menlo Park, CA), JAMES LARIMER, JENNIFER GILLE (NASA, Ames Research Center, Moffett Field, CA), and CHARLES REED (Temple Univ., Philadelphia, PA) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 448-456. Research supported by National Research Council refs
(Contract NCC2-643)
Copyright

Most virtual-reality systems use LCD-based displays that achieve a large field-of-view at the expense of resolution. A typical display will consist of approximately 86,000 pixels uniformly distributed over an 80-degree by 60-degree image. Thus, each pixel subtends about 13 minutes of arc at the retina; about the same as the resolvable features of the 20/200 line of a Snellen Eye Chart. The low resolution of LCD-based systems limits task performance in some applications. We have examined target-detection performance in a low-resolution virtual world. Our synthesized three-dimensional virtual worlds consisted of target objects that could be positioned at a fixed distance from the viewer, but at random azimuth and constrained elevation. A virtual world could be bounded by chromatic walls or by wire-frame, or it could be unbounded. Viewers scanned these worlds and indicated by appropriate gestures when they had detected the target object. By manipulating the viewer's field size and the chromatic and luminance contrast of annuli surrounding the field-of-view, we were able to assess the effect of field size on the detection of virtual objects in low-resolution synthetic worlds. Author

A93-33444 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PROPOSED EVALUATION FRAMEWORK FOR ASSESSING OPERATOR PERFORMANCE WITH MULTISENSOR DISPLAYS
DAVID C. FOYLE (NASA, Ames Research Center, Moffett Field; U.S. Navy, Naval Weapons Center, China Lake, CA) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 514-525. Research supported by U.S. Navy refs
(Contract RTOP 505-64-36)
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Despite aggressive work on the development of sensor fusion algorithms and techniques, no formal evaluation procedures have been proposed. Based on existing integration models in the literature, an evaluation framework is developed to assess an operator's ability to use multisensor, or sensor fusion, displays. The proposed evaluation framework for evaluating the operator's ability to use such systems is a normative approach: The operator's performance with the sensor fusion display can be compared to the models' predictions based on the operator's performance when viewing the original sensor displays prior to fusion. This allows for the determination as to when a sensor fusion system leads to: 1) poorer performance than one of the original sensor displays (clearly an undesirable system in which the fused sensor system causes some distortion or interference); 2) better performance than with either single sensor system alone, but at a sub-optimal (compared to the model predictions) level; 3) optimal performance (compared to model predictions); or, 4) super-optimal performance, which may occur if the operator were able to use some highly diagnostic 'emergent features' in the sensor fusion display, which were unavailable in the original sensor displays. An experiment demonstrating the usefulness of the proposed evaluation framework is discussed. Author

A93-33445* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE DESIGN OF VIRTUAL SPACES AND VIRTUAL ENVIRONMENTS
STEPHEN R. ELLIS (NASA, Ames Research Center, Moffett Field; California Univ., Berkeley) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 536-540. refs
Copyright

Two examples of displays designed to aid spatial maneuvering are described. The first, a perspective format for a commercial air traffic display, illustrates how geometric distortion may be introduced to insure that an operator can understand a depicted three-dimensional situation. The second, a display for planning small aircraft maneuvers, illustrates how the complex counter-initiative character of orbital maneuvering can be made more tractable by removing higher-order nonlinear control dynamics and allowing independent satisfaction of velocity and plume impingement constraints on orbital changes. AIAA

A93-33446* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DEPTH CUE INTERACTION IN TELEPRESENCE AND SIMULATED TELEMANIPULATION
ANDREW LIU, GREGORY THARP, and LAWRENCE STARK (California Univ., Berkeley) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 541-547. refs
(Contract NCC2-86)
Copyright

We examined the contribution of two important depth cues, occlusion and disparity, on the performance of a simulated telerobotic task. We have simulated a three-axis tracking task that is viewed under four different levels of realism. We hoped to determine if the combined presentation of the depth cues has a more beneficial effect on performance than either depth cue

presented singularly. Results showed similar performance improvements with the presentation of occlusion or disparity individually. When both cues were present together, a somewhat larger performance improvement was measured. Author

A93-33447
HUMAN BEHAVIOR IN VIRTUAL ENVIRONMENTS
MICHITAKA HIROSE, KOUICHI HIROTA, and RYUGO KIJIMA (Tokyo Univ., Japan) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 548-559. refs
Copyright

Object manipulation performance in a virtual environment is discussed, with particular attention given to stereo visual cues, motion parallax, and force sensation. With respect to visual factors, it is shown that the use of stereo display and motion parallax may help in improving performance. With respect to force/touch sensation, the contribution of touch sensation in the environment recognition activity is not large, but that of the constraint force is substantial. The boundary constraints for the motion of an operator are found to be particularly important in providing realistic sensations. AIAA

A93-33448* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A TELEOPERATION TRAINING SIMULATOR WITH VISUAL AND KINESTHETIC FORCE VIRTUAL REALITY
WON S. KIM and PAUL SCHENKER (JPL, Pasadena, CA) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 560-569. refs
Copyright

A force-reflecting teleoperation training simulator with a high-fidelity real-time graphics display has been developed for operator training. A novel feature of this simulator is that it enables the operator to feel contact forces and torques through a force-reflecting controller during the execution of the simulated peg-in-hole task, providing the operator with the feel of visual and kinesthetic force virtual reality. A peg-in-hole task is used in our simulated teleoperation trainer as a generic teleoperation task. A quasi-static analysis of a two-dimensional peg-in-hole task model has been extended to a three-dimensional model analysis to compute contact forces and torques for a virtual realization of kinesthetic force feedback. The simulator allows the user to specify force reflection gains and stiffness (compliance) values of the manipulator hand for both the three translational and the three rotational axes in Cartesian space. Three viewing modes are provided for graphics display: single view, two split views, and stereoscopic view. Author

A93-33449* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TIMING CONSIDERATIONS OF HELMET MOUNTED DISPLAY PERFORMANCE
GREGORY THARP, ANDREW LIU, LLOYD FRENCH, STEVE LAI, and LAWRENCE STARK (California Univ., Berkeley) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 570-576. refs
(Contract NCC2-86)
Copyright

The Helmet Mounted Display (HMD) system developed in our lab should be a useful teleoperator systems display if it increases operator performance of the desired task; it can, however, introduce degradation in performance due to display update rate constraints and communication delays. Display update rates are slowed by communication bandwidth and/or computational power limitations. We used simulated 3D tracking and pick-and-place tasks to characterize performance levels for a range of update rates. Initial experiments with 3D tracking indicate that performance levels plateau at an update rate between 10 and 20 Hz. We have found that using the HMD with delay decreases performance as delay increases. Author (revised)

A93-33450
VISUAL SEARCH IN VIRTUAL ENVIRONMENTS
L. W. STARK, K. EZUMI, T. NGUYEN, R. PAUL, G. THARP, and H. I. YAMASHITA (California Univ., Berkeley) *In* Human vision, visual processing, and digital display III; Proceedings of the Meeting, San Jose, CA, Feb. 10-13, 1992 Bellingham, WA Society of Photo-Optical Instrumentation Engineers 1992 p. 577-589. Research supported by U.S. Army refs
Copyright

Different search strategies emerging under different scene and task conditions are investigated in an attempt to obtain quantitative measures of human performance and documentation of visual search strategies. In particular, three experimental arrangements, with eye, head, and mouse control of viewing windows, are used by employing various combinations of helmet-mounted displays, graphics workstations, and eye movement tracking facilities. Two different categories of viewing strategies are contrasted: (1) two-dimensional pictures with large numbers of targets and clutter scattered randomly and (2) quasi-natural three-dimensional scenes with targets and nontargets placed in realistic positions. The dependence of the emerging search strategies on the level of 'virtuality' of the display is discussed. AIAA

N93-22628*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CLOSED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS) TEST FACILITY
ROBERT D. MACELROY *In* NASA, Washington, Space Station Freedom Utilization Conference p 283-290 1992
Avail: CASI HC A02/MF A04

The CELSS Test Facility (CTF) is being developed for installation on Space Station Freedom (SSF) in August 1999. It is designed to conduct experiments that will determine the effects of microgravity on the productivity of higher (crop) plants. The CTF will occupy two standard SSF racks and will accommodate approximately one square meter of growing area and a canopy height of 80 cm. The growth volume will be isolated from the external environment, allowing stringent control of environmental conditions. Temperature, humidity, oxygen, carbon dioxide, and light levels will all be closely controlled to prescribed set points and monitored. This level of environmental control is needed to prevent stress and allow accurate assessment of microgravity effect (10-3 to 10-6 x g). Photosynthetic rates and respiration rates, calculated through continuous recording of gas concentrations, transpiration, and total and edible biomass produced will be measured. Toxic byproducts will be monitored and scrubbed. Transpiration water will be collected within the chamber and recycled into the nutrient solution. A wide variety of crop plants, e.g., wheat, soy beans, lettuce, potatoes, can be accommodated and various nutrient delivery systems and light delivery systems will be available. In the course of its development, the CTF will exploit fully, and contribute importantly, to the state-of-art in closed system technology and plant physiology. Author (revised)

N93-22640*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ZERO-G LIFE SUPPORT FOR SPACE STATION FREEDOM
MATTHEW KOLODNEY (Lockheed Engineering and Sciences Co., Houston, TX.) and L. DALL-BAUMAN *In* NASA, Washington, Space Station Freedom Utilization Conference p 407-414 1992
Avail: CASI HC A02/MF A04

Optimal design of spacecraft environmental control and life support systems (ECLSS) for long duration missions requires an understanding of microgravity and its long-term influence on ECLSS performance characteristics. This understanding will require examination of the fundamental processes associated with air revitalization and water recovery in a microgravity environment. Short term testing can be performed on NASA's reduced gravity aircraft (a KC-135), but longer tests will need to be conducted on

the shuttle or Space Station Freedom. Conceptual designs have been prepared for ECLSS test beds that will allow extended testing of equipment under microgravity conditions. Separate designs have been formulated for air revitalization and water recovery test beds. In order to allow testing of a variety of hardware with minimal alteration of the beds themselves, the designs include storage tanks, plumbing, and limited instrumentation that would be expected to be common to all air (or water) treatment equipment of interest. In the interest of minimizing spacecraft/test bed interface requirements, the beds are designed to recycle process fluids to the greatest extent possible. In most cases, only cooling water and power interfaces are required. A volume equal to that of two SSF lockers was allowed for each design. These bed dimensions would limit testing to equipment with a 0.5- to 1.5-person-equivalent throughput. The mass, volume, and power requirements for the air revitalization test bed are estimated at 125-280 kg, 1.0- 1.4 cubic meters, and 170 min 1070 W. Corresponding ranges for the water recovery test bed are 325-375 kg, 1.0- 1.1 cubic meters, and 350-850 W. These figures include individual test articles and accompanying hardware as well as the tanks, plumbing, and instrumentation included in the bed designs. Process fluid weight (i.e., water weight) is also included. Author

N93-22663*# Life Systems, Inc., Cleveland, OH.
INTEGRATED OXYGEN RECOVERY SYSTEM Bimonthly Technical Progress Report No. 1, 8 Jan. - 8 Mar. 1993
M. GENE LEE and RONALD J. DAVENPORT 8 Mar. 1993 21 p
(Contract NAS8-39843)
(NASA-CR-192343; NAS 1.26:192343; TR-1619-1-1) Avail: CASI HC A03/MF A01

Life Systems has conceptualized an innovative Integrated Oxygen Recovery System (IORS) applicable to advanced mission air revitalization. The IORS provides the capability to electrochemically generate metabolic oxygen (O2) and recover O2 from the space habitat atmosphere via a carbon dioxide (CO2) reduction process within a single assembly. To achieve this capability, the IORS utilizes a Solid Metal Cathode (SMC) water electrolysis unit that simultaneously serves as the Sabatier CO2 reduction reactor. The IORS enables two major life support systems currently baselined in closed loop air revitalization systems to be combined into one smaller, less complex system. This concept reduces fluidic and electrical interface requirements and eliminates a hydrogen (H2) interface. Life Systems is performing an evaluation of the IORS process directed at demonstrating performance and quantifying key physical characteristics including power, weight, and volume. Technical progress achieved during the first two months of the program is summarized. Author

N93-23129*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EVALUATION OF HOLE SIZES IN STRUCTURES REQUIRING EVA SERVICES AS A MEANS TO PREVENT GLOVED-HAND FINGER ENTRAPMENT
SUDHAKAR L. RAJULU (Lockheed Engineering and Sciences Co., Houston, TX.) and GLENN K. KLUTE Apr. 1993 15 p
(Contract NAS9-17900)
(NASA-TM-104767; S-717; NAS 1.15:104767; LESC-30689)
Avail: CASI HC A03/MF A01

One of the concerns of Space Station designers was making sure that the suited crewmembers' gloved fingers are not trapped in the holes that may be present in the structures during EVA activities. A study was conducted on 11 subjects to determine the minimum and maximum possible hole sizes that would eliminate the possibility of finger entrapment. Subjects wore pressurized gloves and attempted to insert their fingers into holes of various sizes. Based on the experimental results, it is recommended that the smallest diameter should be less than 13.0 mm and the largest diameter should be greater than 35.0 mm in order to eliminate the possibility of finger entrapment while wearing gloves. It is also recommended that the current requirements specified by the MSIS-STD-3000 (Section 6.3.3.4) should be modified accordingly. Author

N93-23451# Naval Air Warfare Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
THE EFFECTS OF DISPLAY AND RESPONSE CODES ON INFORMATION PROCESSING IN AN IDENTIFICATION TASK Ph.D. Thesis Final Report
JEFFREY G. MORRISON 23 Sep. 1992 341 p
(AD-A259531; NAWACDWAR-92088-60; NADC-92088-60) Avail: CASI HC A15/MF A03

Four experiments are reported that employ the Within-Task Subtractive (WiTS) method for partitioning response time. The assumptions and advantages of this methodology are discussed relative to subtractive and additive factors methodology. Code and coding issues such as the particular target-task combination used, response mapping, target density, and blocks were manipulated. Study 1 showed that digits were processed differently from letters in terms of input and output processing. Study 2 showed that the identification of different categories of codes in the presence of noise codes generated different effects on input and output processing. Study 3 examined the identification of codes from multiple code categories when there is a single code per target versus when there are multiple codes per target. The results show that while there are differences in input processing depending on the location of codes, when the results are considered on a per-code basis, the differences in input are accounted for by the different number of visual fixations required, rather than differences in processing. Study 4 examined the effects of identifying redundant codes. Redundant codes were processed as separate codes early in practice, and processed as a single, composite code late in practice during input, and were output much faster than relevant, non-redundant codes in output. GRA

N93-23647# Galaxy Scientific Corp., Atlanta, GA.
HUMAN FACTORS ISSUES IN AIRCRAFT MAINTENANCE AND INSPECTION. SCIENCE, TECHNOLOGY, AND MANAGEMENT: A PROGRAM REVIEW
Aug. 1992 252 p Meeting held in Atlanta, GA, 5-6 Aug. 1992
(Contract DTFA01-92-Y-01005)
(PB93-146975) Avail: CASI HC A12/MF A03

The report presents the proceedings of the seventh in a series of meetings sponsored by the Federal Aviation Administration (FAA). These meetings address issues of human factors in aviation maintenance and inspection. This two-day meeting, in August 1992, directed attention to science, technology, and management. This triad was addressed by eighteen speakers from industry, government, the Department of Defense, and academia. Many of the presentations served as a review of the Human Factors in Aviation Maintenance Research Program. The Office of Aviation Medicine Human Factors in Aviation Maintenance Research Program has responded to many of the topics in the National Plan for Aviation Human Factors. The National Plan combines issues of science and technology with a management plan to define approaches to a broad range of human factors issues in aviation. The MM's responses are presented. The responses address topics related to work environments, tools, procedures, training, documentation, and innovative maintenance management practices. The Aviation Medicine research is complimented by presentations from airline, manufacturers, and Department of Defense personnel. GRA

N93-23660# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
COMPARATIVE EVALUATION OF A MONOCULAR HEAD MOUNTED DISPLAY DEVICE VERSUS A FLAT SCREEN DISPLAY DEVICE IN PRESENTING AIRCRAFT MAINTENANCE TECHNICAL DATA M.S. Thesis
JEFFREY A. FRIEND and RANDY S. GRINSTEAD Sep. 1992 166 p
(AD-A259684; AFIT/GSM/LSM/92S-8) Avail: CASI HC A08/MF A02

As military developers provide increasingly complex weapon systems, it becomes more difficult for maintenance technicians to perform their jobs. One aspect of the technicians' world is the need to access technical information in the performance of their

duties. This study investigated two electronic display systems to evaluate which enhanced technician performance more. A Head Mounted Display (HMD) device and a portable hand-held flat-screen computer were evaluated in the performance of two flightline maintenance activities. Although both display systems were fully portable and self contained, only the HMD system allowed continuous access to technical information during task performance. In most cases, technicians using the IBM system outperformed those equipped with the flat-screen computer system in terms of effectiveness and efficiency. GRA

N93-23992# Army Aeromedical Research Lab., Fort Rucker, AL.
IN-FLIGHT FIELD-OF-VIEW WITH ANVIS Final Report
JOHN C. KOTULAK Dec. 1992 69 p
(Contract DA PROJ. 3M1-62787-A-879)
(AD-A259905; USAARL-93-8) Avail: CASI HC A04/MF A01

This investigation had four major goals: (1) to measure the in-flight field-of-view (FOV) of a large sample of aviators (n = 105) using the AN/AVS-6 Aviator's Night Vision Imaging System (ANVIS); (2) to assess the degree to which in-flight ANVIS FOV restrictions result from improper user adjustments as opposed to equipment limitations; (3) to determine which epidemiological factors might be associated with reduced FOV; and (3) to evaluate options for optimizing in-flight ANVIS FOV. It was concluded that only about 15 percent of aviators actually achieve a 40 deg FOV with ANVIS during flight. The FOV's were reduced mostly because of equipment limitations, and not because of user misadjustments. Specifically, the fore-aft adjustment of the ANVIS helmet mount lacks sufficient range in the aft direction. Among the epidemiological factors studied, only total flight hours, hours in current aircraft, hours in last 12 months, and aircraft type are statistically related to in-flight ANVIS FOV. Total night vision goggle flight hours, ANVIS flight hours, helmet size, type of helmet liner, and spectacle use are not related to in-flight ANVIS FOV. Finally, it was determined that most aviators could achieve a 40 deg FOV if either of two hardware modifications were made: improving the fore-aft adjustment range of the ANVIS mount, or switching to a different eyepiece with a greater eye relief. GRA

N93-23995# Army Aeromedical Research Lab., Fort Rucker, AL.
EFFECTS ON PHYSIOLOGY AND PERFORMANCE OF WEARING THE AVIATOR NBC ENSEMBLE WHILE FLYING THE UH-60 HELICOPTER FLIGHT SIMULATOR IN A CONTROLLED HEAT ENVIRONMENT Final Report, Aug. 1989 - Nov. 1991
ROBERT THORNTON, J. L. CALDWELL, WAYNE CLARK, FRANK GUARDIANI, and JOSE ROSARIO Sep. 1992 173 p
(AD-A259909; USAARL-92-36) Avail: CASI HC A08/MF A02

The physiological and performance effects of wearing U.S. Army aviator NBC individual protective equipment (IPE) were evaluated in the USAARL UH-60 research flight simulator. Sixteen male aviators flew the simulator in four test conditions: standard flight suit and cool cockpit, standard flight suit and hot cockpit, NBC IPE and cool cockpit, and NBC IPE and hot cockpit. The hot condition had a wet bulb globe temperature (WBGT) of 30.6 C, the cool 17.9 C. Rectal temperature, mean skin temperature, and heart rate were monitored and showed significant increases for the NBC hot condition compared with the other three. There was a significant degree of dehydration in the hot NBC condition. Seven subjects failed to complete the sortie in the NBC hot condition, with a mean survival time of 298 minutes. All subjects flew for the target 6 hours in the other conditions. Simulator flight performance showed significant impairment in the hot NBC condition. There was little evidence of a reduction in flight performance with time. Six crashes occurred in NBC IPE, one in the standard flight suit. A performance assessment battery also was undertaken before, and at regular intervals during flight. The battery showed no effect of condition, though it was sensitive to increasing time on each test day. A subjective questionnaire assessment showed increasing fatigue with time, and that all conditions produced significantly more fatigue than baseline with the worse being for NBC hot. GRA

N93-24001# Dynamics Research Corp., Wilmington, MA.
ATTENTION FACTORS ASSOCIATED WITH HEAD-UP DISPLAY AND HELMET-MOUNTED DISPLAY SYSTEMS Final Report, Jul. - Dec. 1991
JOHN C. MOREY and ROBERT SIMON Jan. 1993 64 p
(Contract MDA903-87-C-0523)
(AD-A260204; E-19298U; ARI-RN-93-12) Avail: CASI HC A04/MF A01

A review of human attention research literature relevant to head-up display (HUD) and helmet-mounted display (HMD) systems in use or under development for rotary-wing aircraft is presented. The fundamental attentional issue for HUD's and HMD's is division of attention between the outside-the-window scene and the displayed symbology. Selective attention applies more to elements within the HUD or HMD symbology. The review identified a number of areas for further research. These are effects of dichoptic viewing, eye dominance, identification of strategies for effective time-sharing, HUD and HMD training, and pilot selection. GRA

N93-24067# Wright State Univ., Dayton, OH. Dept. of Psychology.
PERCEPTION/ACTION: AN HOLISTIC APPROACH Final Report, 15 Dec. 1990 - 29 Aug. 1992
JOHN M. FLACH Oct. 1992 46 p
(Contract AF-AFOSR-1051-91)
(AD-A259597; WSU-FR-661805; AFOSR-92-1019TR) Avail: CASI HC A03/MF A01

A general systems approach is taken to studying the emergent properties of the human perception/action system. Two task domains, the control of locomotion and the recognition of objects, are used to study human performance. The locomotion task involves the control of altitude. Experiments are described that will manipulate the type of texture, the speed of forward motion, and altitude. A general hypothesis is presented that performance in the altitude control task is a function of the signal-to-noise ratio within the flow field--where signal refers to optical activity resulting from change of altitude and noise refers to optical activity resulting from other sources. An analysis of the flow geometry is presented to illustrate how the motion of the observer and the position of texture elements combine to determine the optical information available to the observer. The object recognition task involves the discrimination of 3-dimensional wire-frame forms using the information available in dynamic occlusion. A key manipulation within this task was the mode of observation. Observers were either active (they could manipulate the object using a joystick to produce dynamic occlusion) or they were passive (they could observe the motions produced by the active observer, but they could not act on the display to produce dynamic occlusions). Three experiments are presented. The most important result was that no differences were found as a function of mode. In all three experiments passive observers performed at least as well as active observers. GRA

N93-24128# Programming and Systems Management, Inc., Dayton, OH.
AN INNOVATIVE METHOD FOR HAND PROTECTION FROM EXTREME COLD USING HEAT PIPE Final Report, 1 Jul. 1986 - Feb. 1987
A. FAGHRI, D. B. REYNOLDS, and B. BAHRAMIAN Dec. 1992 75 p
(AD-A259720; NATICK-TR-93/005) Avail: CASI HC A04/MF A01

Due to the danger of frostbite at very low ambient temperatures, there is a need to develop new handwear technology to protect the fingers at temperatures down to about -80 F (-62 C). The shortcomings of the existing technology, a glove with a heating element, are needed for maintenance, size, and limited capacity of the current batteries. An innovative method was investigated to transfer some of the body core thermal energy to the hands. This method involves the use of heat pipe technology, which has the

advantages of very high effective heat conductivity, fast response time, flexibility low mass, compact size, and ease of maintenance. The design uses the person's elbow area as the heat source. The heat pipe extends along the arm and terminates at the surface of the back of the hand. From a simple model of the insulated arm and hand, the required heat transfer to the hand by the heat pipe to maintain a hand temperature of -81 F (27 C) with ambient temperature of -80 F (62 C) was shown to vary from 5.8 to 21 W for an insulation 'R' value from 0.741 to 0.185 m(sup 2)C/W. A very efficient and flexible heat pipe was developed and tested to show the feasibility of the use of heat pipe technology in the above application. Heat capacities between 1 and 5 W were measured, depending upon orientation with respect to gravity. Due to the necessity of transferring 1 to 5 times this amount of heat and to provide for more uniform heat distribution, these results indicate that multiple heat pipes may be required in the design of a handwear system. GRA

N93-24168# Aeronautical Systems Div., Wright-Patterson AFB, OH.

ATTITUDE AWARENESS ENHANCEMENTS FOR THE F-16 HEAD-UP DISPLAY Final Report, 1 Mar. - 30 Jun. 1992

SCOTT M. CONE and JOHN A. HASSOUN Oct. 1992 47 p (AD-A260280; ASC-TR-92-5017) Avail: CASI HC A03/MF A01

In an effort to reduce the Collision With Ground (CWG) and Spatial Disorientation (SDO) mishaps, the F-16 System Program Office (SPO) has initiated an effort to improve F-16 C/D head-up display (HUD) symbology. In support of this effort, the SPO identified a set of attitude awareness enhancements for potential incorporation into the aircraft. These were (1) extended horizon, (2) ghost horizon, (3) articulated nose down pitch bars, (4) removal of 2:1 pitch scale compression, (5) moving nose down pitch bar tic marks to the inside of the pitch bars, (6) modified bank angle indicator, and (7) modified zenith/nadir symbols. Prior to the incorporation of these enhancements, the Crew Station Evaluation Facility (CSEF) performed a simulation evaluation to assess the improvement in attitude awareness provided by these changes. Fifteen pilots flew a series of unusual attitude recoveries and mission demonstration tasks during which reaction time, error rate, and subjective ratings were collected. Results showed faster reaction times, especially in nose-down conditions, and strong subjective preference for the modified HUD format. Based on these results, the CSEF recommended the incorporation of the extended horizon, ghost horizon, modified pitch ladder, and modified zenith/nadir symbols (low priority). Ratings for the bank angle indicator were mixed. It is recommended that the bank angle indicator be evaluated in instrument flying conditions before being considered for incorporation into the F-16 HUD. GRA

N93-24362# Innsbruck Univ. (Austria). Dept. for Neurology.

EYE-HEAD-ARM COORDINATION AND SPINAL REFLEXES IN WEIGHTLESSNESS

M. BERGER, F. GERSTENBRAND, N. BURLATSCHKOVA, A. MUIGG, L. GRILL, G. HOLZMUELLER, I. B. KOZLOVSKAYA (Institute of Biomedical Problems, Moscow, USSR.), M. BORISOV (Institute of Biomedical Problems, Moscow, USSR.), B. BABAEV (Institute of Biomedical Problems, Moscow, USSR.), A. SOKOLOV (Institute of Biomedical Problems, Moscow, USSR.) et al. *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 139-145 Jul. 1992

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The method and results of the MoniMir experiment, part of the investigation program of the Austrian Soviet spaceflight in Oct. 1991, which investigated the adaptation and readaptation of eye, head, and arm movements, are presented. The movements are highly coordinated under the control of visual, vestibular, and proprioceptive systems. Disturbances on the vestibular and proprioceptive systems caused by weightlessness during spaceflight are responsible for initial movement disorders in space. Visual information is primarily responsible for adaptation of the sensory motor system. Special hardware was developed for the presentation of standardized visual signals and for registration of eye, head, and arm movements. Preprogrammed movements, tracking movements, memorization of movements, and the influence of neck reflexes on arm movements were investigated. Analysis of accuracy, velocity, reproducibility of eye, head, and arm movements, and their changes during and after spaceflight gives further information on the adaptive process of the sensory motor system. ESA

N93-24406# Ruhr Univ., Bochum (Germany). Comparative Endocrinology Research Station.

ECOSYSTEMS ON EARTH AND IN SPACE (THE POSSIBLE UTILIZATION OF ARTIFICIAL ECOSYSTEMS FOR SPACE LIFE SUPPORT SYSTEMS)

V. BLUEM *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 393-398 Jul. 1992

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The possibilities and constraints of the utilization of biogenerative systems for space life support systems are discussed and examples of past and current scientific activities in this field are demonstrated. On Earth organism are influenced by two types of environmental factors: abiotic (e.g., temperature, medium salinity) and biotic ones (e.g., food, predators). During evolution organisms had to avoid or to adapt to given or changing factors and they are linked in different levels into regenerative cycles for oxygen, nitrogen and water which guarantee the maintenance of life together with the essential solar energy. In space the environmental factors are lethal for living beings and for spaceflight life support systems are an essential precondition. Until today these are 'alimentary', i.e., all food, water and oxygen has to be brought into and the wastes have to be removed form the protective environment. ESA

N93-24441# Army Aeromedical Research Lab., Fort Rucker, AL.

AN AUTOMATED METHOD FOR DETERMINING MASS PROPERTIES Final Report

MICHAEL B. DEAVERS and B. J. MCENTIRE Dec. 1992 33 p (AD-A259924; USAARL-93-4) Avail: CASI HC A03/MF A01

The U.S. Army Aeromedical Research Laboratory performs mass properties testing with the KSR330-60 Mass Properties Instrument (MPI). For man-mounted equipment, it is important to define and measure the mass properties in order to accurately develop math models, understand human performance impacts, and to conduct comparative evaluations. Determining mass properties requires a thorough theoretical understanding of the center-of-mass and mass moments of inertia. This report provides the operating theory and procedures to measure mass properties with the MPI. GRA

N93-24490*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A DEMONSTRATION OF MOTION BASE DESIGN ALTERNATIVES FOR THE NATIONAL ADVANCED DRIVING SIMULATOR

MICHAEL E. MCCAULEY (Monterey Technologies, Inc., Carmel, CA.), THOMAS J. SHARKEY (Monterey Technologies, Inc., Carmel, CA.), JOHN B. SINACORI (Sinacori, John B. Associates, Hollister, CA.), SOREN LAFORCE (SYRE Corp., Moffett Field, CA.), JAMES C. MILLER, and ANTHONY COOK Oct. 1992 24 p (Contract RTOP 505-64-29)

(NASA-TM-103881; A-91204; NAS 1.15:103881) Avail: CASI HC A03/MF A01

A demonstration of the capability of NASA's Vertical Motion Simulator to simulate two alternative motion base designs for the National Advanced Driving simulator (NADS) is reported. The VMS is located at ARC. The motion base conditions used in this demonstration were as follows: (1) a large translational motion base; and (2) a motion base design with limited translational capability. The latter had translational capability representative of

a typical synergistic motion platform. These alternatives were selected to test the prediction that large amplitude translational motion would result in a lower incidence or severity of simulator induced sickness (SIS) than would a limited translational motion base. A total of 10 drivers performed two tasks, slaloms and quick-stops, using each of the motion bases. Physiological, objective, and subjective measures were collected. No reliable differences in SIS between the motion base conditions was found in this demonstration. However, in light of the cost considerations and engineering challenges associated with implementing a large translation motion base, performance of a formal study is recommended. Author (revised)

N93-24502# Sandia National Labs., Albuquerque, NM.
TREATMENT OF HUMAN-COMPUTER INTERFACE IN A DECISION SUPPORT SYSTEM
A. S. HEGER, F. A. DURAN (New Mexico Univ., Albuquerque.), S. FRYSINGER (Bell Telephone Labs., Inc., Holmdel, NJ.), and R. G. COX 1992 5 p Presented at the 1992 IEEE System, Man and Cybernetics Conference, Chicago, IL, 18-21 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-002281; SAND-92-1903C; CONF-9210177-2) Avail: CASI HC A01/MF A01

One of the most challenging applications facing the computer community is development of effective adaptive human-computer interface. This challenge stems from the complex nature of the human part of this symbiosis. The application of this discipline to the environmental restoration and waste management is further complicated due to the nature of environmental data. The information that is required to manage environmental impacts of human activity is fundamentally complex. This paper discusses the efforts at Sandia National Laboratories in developing the adaptive conceptual model manager within the constraint of the environmental decision-making. A computer workstation, that hosts the Conceptual Model Manager and the Sandia Environmental Decision Support System is also discussed. DOE

N93-25099# Oak Ridge National Lab., TN.
INITIAL EXPERIMENTS WITH A MYOELECTRIC-BASED MUSCLE SENSOR
J. F. JANSEN 1992 21 p *Presented at the Institute of* Electrical and Electronics Engineers International Conference on Robotics and Automation, Atlanta, GA, 2-7 May 1993
(Contract DE-AC05-84OR-21400)
(DE92-016034; CONF-930519-1) Avail: CASI HC A03/MF A01

This paper describes initial experiments in which a myoelectric-based sensor is used to measure local muscle activity in the human body -- specifically the hand muscles. Applications of this sensor are twofold: (1) to quantify the voluntary muscular activity of specific muscles for human factors studies and (2) to allow a human operator to control a mechanical hand in teleoperation mode. Discussions are focused mainly on the measurement of muscle activity and how it relates to controlling a mechanical hand. Supportive experimental results are given. DOE

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N93-23908# Observatoire de Paris-Meudon (France).
SETI IN EUROPE
JEAN HEIDMANN *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Space Sciences with Particular Emphasis on High-Energy Astrophysics p 165-166 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The contribution to SETI (Search for Extraterrestrial Intelligence) and to bioastronomy by European workers is evaluated. It reaches the level of 24 percent of the total international input. Contributors are France, Austria, and Italy. Europe contributes most to SETI strategies. France is the sole contributor to real searches and Italy has search projects. ESA

N93-24373# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Biophysics Div.
LIFE IN AND FROM SPACE
G. HORNECK *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 207-210 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Certain questions are addressed with the aim of investigating whether life is an integral part of cosmic evolution relevant to any celestial body given enough time and the right environmental and statistic conditions. The general principles of life and the environmental requirements and boundary conditions of life are discussed. The criteria for habitability of a celestial body are also discussed together with the chances of distribution of life between different celestial bodies. ESA

N93-24405# Centre National de la Recherche Scientifique, Orleans (France). Centre de Biophysique Moleculaire.
EXOBIOLOGY AND TERRESTRIAL LIFE
ANDRE BRACK *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Columbus Eight (COSY-8): Utilisation of Earth Orbiting Laboratories p 387-391 Jul. 1992
Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Terrestrial life can be schematically described as organic molecules organized in liquid water. According to Oparin's hypothesis, organic building blocks required for early life were produced from simple organic molecules formed in a primitive reducing atmosphere. Some precursors of biomolecules have been obtained in the laboratory. Geochemists favor now a less reducing atmosphere dominated by carboin dioxide. In such an atmosphere, very few building blocks are formed. Import of extraterrestrial organic molecules may represent an alternative supply. Experimental support for such an alternative scenario is examined in comets, meteorites and micrometeorites. In contrast to the classical scenario, a chemoautotrophic origin of life is discussed. Finally, interesting information related to early terrestrial life may be gained from Mars exploration. ESA

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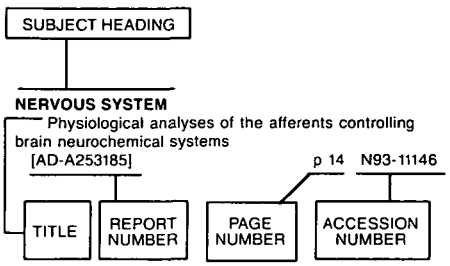

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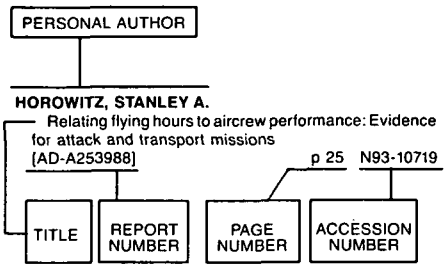

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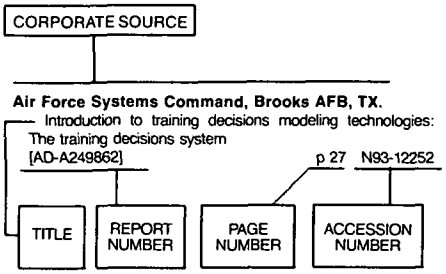

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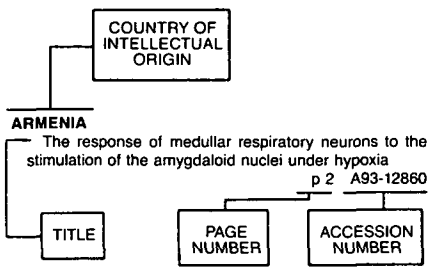

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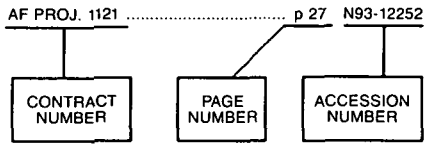

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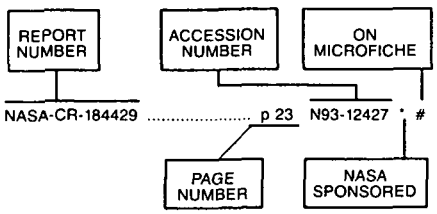

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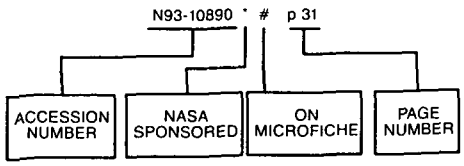

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UNIV. OF IDAHO LIBRARY
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ILLINOIS STATE LIBRARY
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(217) 782-7596 FAX: (217) 524-0041

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INDIANA STATE LIBRARY
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Indianapolis, IN 46204
(317) 232-3678 FAX: (317) 232-3728

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UNIV. OF IOWA LIBRARIES
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Iowa City, IA 52242
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KANSAS

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Govt. Documents & Map Library
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Lawrence, KS 66045-2800
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Middleton Library
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Baton Rouge, LA 70803
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LOUISIANA TECHNICAL UNIV.
Prescott Memorial Library
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305 Wisteria Street
Ruston, LA 71270-9985
(318) 257-4962 FAX: (318) 257-2447

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Govt. Documents & Microforms Dept.
Univ. of Maine
Orono, ME 04469
(207) 581-1680

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UNIV. OF MARYLAND
Hornbake Library
Govt. Documents/Maps Unit
College Park, MD 20742
(301) 454-3034 FAX: (301) 454-4985

MASSACHUSETTS

BOSTON PUBLIC LIBRARY
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Boston, MA 02117
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FAX: (617) 267-8273; 267-8248

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MINNESOTA

UNIV. OF MINNESOTA
Wilson Library
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309 19th Avenue South
Minneapolis, MN 55455
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UNIV. OF MISSISSIPPI
J.D. Williams Library
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106 Old Gym Bldg.
University, MS 38677
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UNIV. OF MONTANA
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(402) 472-2562

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Reno Library
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Reno, NV 89557
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General Library
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Albuquerque, NM 87131-1466
(505) 277-5441 FAX: (505) 277-6019

NEW MEXICO STATE LIBRARY
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Santa Fe, NM 87503
(505) 827-3826 FAX: (505) 827-3820

NEW YORK

NEW YORK STATE LIBRARY
Documents/Gift & Exchange Section
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Cultural Education Center
Albany, NY 12230
(518) 474-5563 FAX: (518) 474-5786

NORTH CAROLINA

UNIV. OF NORTH CAROLINA - CHAPEL HILL
CB#3912, Davis Library
BA/SS Dept.—Documents
Chapel Hill, NC 27599
(919) 962-1151 FAX: (919) 962-0484

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STATE LIBRARY OF OHIO
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Columbus, OH 43266
(614) 644-7051 FAX: (614) 752-9178

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OKLAHOMA DEPT. OF LIBRARIES
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Oklahoma City, OK 73105-3298
(405) 521-2502, ext. 252, 253
FAX: (405) 525-7804

OKLAHOMA STATE UNIV.
Edmon Low Library
Documents Dept.
Stillwater, OK 74078
(405) 744-6546 FAX: (405) 744-5183

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PORTLAND STATE UNIV.
Millar Library
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Portland, OR 97207
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Cooper Library
Public Documents Unit
Clemson, SC 29634-3001
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In cooperation with Univ. of South Carolina, Thomas Cooper Library, Columbia

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MEMPHIS STATE UNIV. LIBRARIES
Govt. Documents
Memphis, TN 38152
(901) 678-2586 FAX: (901) 678-2511

TEXAS

TEXAS STATE LIBRARY
United States Documents
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Austin, TX 78711
(512) 463-5455 FAX: (512) 463-5436

TEXAS TECH. UNIV. LIBRARY
Documents Dept.
Lubbock, TX 79409
(806) 742-2268 FAX: (806) 742-1920

UTAH

UTAH STATE UNIV.
Merrill Library & Learning Resources Center, UMC-3000
Documents Dept.
Logan, UT 84322-3000
(801) 750-2684 FAX: (801) 750-2677

VIRGINIA

UNIV. OF VIRGINIA
Alderman Library
Govt. Documents
Charlottesville, VA 22903-2498
(804) 924-3133 FAX: (804) 924-4337

WASHINGTON

WASHINGTON STATE LIBRARY
Document Section
MS AJ-11
Olympia, WA 98504-0111
(206) 753-4027 FAX: (206) 753-3546

WEST VIRGINIA

WEST VIRGINIA UNIV. LIBRARY
Govt. Documents Section
P.O. Box 6069
Morgantown, WV 26506
(304) 293-3640

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Govt. Publications Section
816 State Street
Madison, WI 53706
(608) 262-2781 FAX: (608) 262-4711
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